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STRINGING ELECTRICAL WIRES ABOVE THE TRACKS OF A BUSY STEAM RAILROAD WHICH IS BEING ELECTRIFIED.—[See page 95.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Price of Frightfulness

AS we go to press, we have before us a synopsis of the reply of President Wilson to the last communication received from Germany. In declining to humiliate the Government of the United States by accepting the proposals made by Germany that Americans shall be allowed to travel in safety only on certain ships, only four of which are to be belligerent ships, the President has followed the natural course and the only course which was to be expected as upholding the dignity of this nation. The principle at stake is one that involves more even than the loss of American lives. It concerns the well-being of all nations which are not now at war. The assumption that neutrals have no rights that a belligerent nation need respect is one which the United States as the leading neutral nation should strongly protest against. It is not denied that the submarine has introduced new conditions in warfare, but there is no logical reason, because of this assumption, that the commerce of the world and the nations at peace should be molested, or that the lives of the citizens of those nations should be wantonly imperiled. The demand that there should be on the part of the German government a disavowal of the intention to sink the "Lusitania" has always appeared to be the only fictitious feature of the American demands. The intention of the German government and its criminal purposes in planning for the sinking of this passenger vessel are too well known and attested for any expectation that such a demand would be complied with. The warning issued by the German Ambassador before the sailing of the "Lusitania" indicates quite clearly what the intention of the Imperial government was with reference to this act. That Germany has no intention to depart from its crusade against passenger steamers is evidenced by the attempts that have been made against the "Orduna." Owing to the fact that no lives were lost in the attack upon this steamer, comparatively little attention has been directed toward the significance of the act. Although this vessel escaped the fate of the "Lusitania," the crime against humanity was almost greater than in the disaster to the latter. Practically the only excuse which has been made by German apologists for the destruction of the "Lusitania" and the loss of so many hundreds of lives, was the charge that she carried guns, which has been disproved, and that she carried ammunition, which has been admitted, but in the case of the "Orduna" no such reasons have been given, and the act stands forth, therefore, in its flagrant nakedness. Not only have the officers on the watch testified to the fact that they saw the torpedo, but it was only by the narrow margin of ten feet that the German submarine failed to expose the Americans on board the "Orduna" to the same fate as befell our citizens on board the "Lusitania."

When the war first broke out the people of the United States did what they could to observe the injunction of the President to maintain a strict neutrality. The problem naturally presents itself, in view of subsequent events, whether the policy of frightfulness, which is one of the teachings of the German military strategists and which has been so persistently followed out in this war, has been justified as a wise military expedient by the events of the war. We believe that it is one of the most stupendous blunders into which Germany has fallen. Every American is aware of the inner feeling of revulsion which he experienced at the invasion of Belgium, then at the treatment to which its citizens were subjected, later at the wanton destruction and continued effort to destroy the choicest architectural treasures, and then at the horror which ensued with the sinking of the "Lusitania." The feeling of revulsion which is experienced in this country because of these acts of terrorism is sympathized with in every civilized nation, and Germany stands to-day without friends, without support, looked upon with suspicion and regarded as the enemy of humanity.

From letters recently received from Italy, it appears that the hatred created by the German acts of wantonness has played a very vital part in the declaration of war on the part of Italy. It seems strange that the war lords, who have been studying for so many years what they would term the most efficient methods of warfare, should not have anticipated the universal condemnation which their acts brought about. The only possible justification for such acts in their eyes would be success, and these very acts are what have made German success more difficult and have destroyed the reputation for humanity and civilization which Germany possessed in so large a measure before the war broke out.

The Laboratory's the Thing

THERE is no question in our mind that Mr. Edison's suggestion of establishing a research laboratory in which inventions and discoveries of use to the Navy may be developed—a suggestion eagerly accepted and promulgated by Secretary Daniels—is by far the most important feature of the proposed movement to mobilize American inventors in the interest of the American Navy. The same systematic inquiry and experimentation which is pursued by a large manufacturing corporation in order to improve its product and its processes should be followed by the Government in order to perfect its fighting material. An inquiry into the causes of bulb-blackening led to the evolution of the present high efficiency gas-filled tungsten lamp. Who knows what may not come of an inquiry, extending perhaps over years, into the causes of gun erosion?

Bearing in mind what the laboratories of the Geological Survey have done for the mining industry, what the Bureau of Standards has accomplished for manufacturers at large, what the Bureau of Chemistry of the Department of Agriculture is doing for farmers, it seems astonishing indeed that the Navy and the Army should not long ago have had their joint institution in which the most competent scientists are engaged in solving the problems which constantly arise in making rifles and screw propellers, range-finders and ammunition hoists more efficient. When we consider that in the last five years more improvements have been made in electric incandescent lighting than were made in the previous twenty years, thanks to industrial research conducted regardless of expense by a great electrical manufacturing company, when we consider what chemists employed by manufacturers have done in the creation of our magnificent cottonseed and corn products industries, what may not be expected of a Government laboratory in which inventions and discoveries are to be developed for the benefit of the Army and Navy?

Once a laboratory is established along the lines, for example, of the Bureau of Standards, it may be seriously questioned whether we need an Inventors' Board of civilians. Government laboratories conduct splendid investigations of inks, building materials, soils, leathers and a host of substances without the supervision of manufacturers or farmers. If a lay supervising board is considered necessary, merely in order to insure a more sympathetic hearing to the civilian inventor, we doubt whether the board would justify its existence. While it is undeniable that both the Army and the Navy have been lax in encouraging the adoption of meritorious inventions—witness the list which we published last week—it is also undeniable that manufacturers are not much more progressive. The stories of inventors whose devices have been summarily rejected by the Army and Navy only to be adopted by foreign governments find their counterpart in the stories of inventors who have turned in vain from one manufacturer to another in order to obtain recognition. If Sir Hiram Maxim and the Wright brothers were at first refused due recognition, let it not be forgotten that Howe and Morse had to overcome almost insuperable obstacles, in the way of blindness and prejudice, before their sewing machine and telegraph were successfully introduced. Army and Navy officers are human beings like manufacturers, subject to the same failings, subject to the same conservatism. Once a research laboratory for the benefit of the Army and Navy is established, we may expect a change in the Government's attitude toward the inventor. In other words, the mere existence of the laboratory would bring about with it a more liberal policy. The naval bureaus are now overworked. In the Bureau of Ordnance alone it is said one hundred and thirty-five inventions a month have been submitted since the war started. How is it humanly possible for the officers in the bureau to pass anything but a snap judgment upon them? No doubt 90 per cent of them can be dismissed at once as obviously failing to fulfill the requirements of modern warfare. But what of the other 10 per cent? Who can spend weeks in studying a promising design from every angle? No wonder that a Harvey, a Janney or a Lewis is discouraged. It is the system which is at fault rather than Army and Navy officers themselves.

We have spoken of a "joint board" for the Army and Navy, and in closing we wish to emphasize the importance of making this movement apply from the very first to both branches of the Service. So far as the principles are concerned, the objects of the proposed scientific investigation are the same, whether the subject of invention be designed for service in a fort, in the field, or upon a warship. If a Bureau of Inventions is a good thing for the Navy, so it is for the Army. Should the bureau include both services, it will make for economy by reducing the plant and the staff and by avoiding much needless duplication of work.

A College of Technology in the Far West

IN the Throop College of Technology, as recently reorganized, the far western portion of this country possesses an institution for higher technical education such as it has long needed to supply the local demand for men capable of directing great engineering enterprises. Considering to what an extent the prosperity of the West is built upon such enterprises, it is surprising that a Western institution of this character did not arise long ago.

Throop College is situated at Pasadena. It has existed for nearly a quarter of a century, but prior to the year 1908 its energies were spread over a wide range of pedagogic duties and grades of instruction. Between 1908 and 1913 the Board of Trustees carried out courageous and drastic measures of reorganization, which meant abandoning an attendance of nearly 500 students in the various departments, in order that what little was left of the institution might constitute a true technical college, analogous to the famous seats of technical learning in the Eastern States. On its new basis the college started with 27 students, while in the term ending in June of this year the attendance had increased to 91.

At the last commencement exercises President J. A. B. Scherer announced that the institution had received from an unnamed friend a gift of $10,000 toward the equipment of a research laboratory in physical chemistry and $10,000 a year for its maintenance; also that Dr. Arthur A. Noyes was to direct the new laboratory, and divide his time between Throop College and the Massachusetts Institute of Technology. This is unquestionably a notable event, and augurs well for the future growth of technical studies on the Pacific Coast.

Another evidence of the progressive character of this thriving young college is the fact that one of the courses it now offers is a combination of engineering and economics—such as is given at only two other institutions; viz., the "Boston Tech" and the Carnegie Institute of Technology at Pittsburgh. It consists approximately of 75 per cent engineering subjects and 25 per cent economics, using the latter term in a sense broad enough to include, for example, banking and business law and scientific management.

Throop is noteworthy in the attention it gives to the physical welfare of its students. A student must have the approval of the physical director of the college—who is a regular member of the faculty—before his initial registration; a careful health record is kept of each student, physical exercise is recommended according to his individual requirements, and impairment of his health due to neglect of such exercise may lead the faculty to limit his assignment of courses of study. On the other hand, the college rather discourages specialization in athletics and intercollegiate competitions. It is unfortunate that more of our colleges and universities do not strike this golden mean between two much and too little athletics.

An Aurora Seen in the Daytime is described by H. B. Collier in the *Journal* of the Royal Astronomical Society of Canada. The writer was at Viking, Alberta, in lat. 53 deg. N., and observed the aurora half an hour before sunset on April 22nd. Its visibility was due to the fact that a cloud hung above the horizon, serving as a curtain or screen against which the aurora could be seen. The observer states that "numerous bright, hazy, milk-like streamers, appearing to have their source just below the cloud, darted upward, rising about 15 degrees." Several persons besides Mr. Collier witnessed the phenomenon.

Electricity

Powerful Storage Battery Searchlamp.—Realizing the importance of searchlights during the recent disastrous fire of his plant, Thomas A. Edison has brought out a portable searchlamp adapted particularly for city and factory fire departments. It consists of a 20-inch, waterproof projector with a 35 volt, 750 watt nitrogen filled lamp. This is mounted on a pair of wheels so that it may be moved about readily. The lamp is lighted by a storage battery and is designed to give light continuously for seven hours. It throws a beam powerful enough to show up objects half a mile away, and is equipped with a device by which the beam may be spread out for work at close range.

Operation of Electric Ovens.—One of the papers read at the recent annual convention of the American Institute of Electrical Engineers had to do with the economic operation of electric ovens. The author, Percy W. Gumaer, has made a special study of the time necessary to cook various articles. He showed that biscuits require a temperature of at least 200 deg. Cent., while beef can be roasted at from 100 to 120 degrees. Vegetables also can be cooked at low temperatures and usually the low temperature gives the most economical rate of cooking. Mr. Gumaer believes that the operation, quite as much as the construction, of the electric stove, needs careful study before it will come into general use.

Dirigible Searchlight for Motor Cars.—A new form of searchlight for automobiles has recently appeared on the market. This light is so arranged that it may be turned by the driver at will. It is not to be confused with the type of searchlamp that turns automatically with the wheels so as to show the road ahead when the car is making a turn. The object of the dirigible searchlight is to enable the driver of the car to read signboards, or pick up objects along the road that are not illuminated by the ordinary headlights. The searchlight may be operated with the usual lighting system of the car, as it requires but six volts. It is attached to the wind shield by means of a universal joint. It should prove of value to delivery wagons, and also as a trouble finder in case of an accident along the road.

Electrical Operated Suction Dredge.—An electric dredge is being used in the construction of a cut on the Cuyahoga River, Cleveland, Ohio. The machinery is operated by three-phase 2,200-volt motors, which obtain their current by cable from a transmission line on shore that parallels the cut. The dredge, which is of the suction type, has 16-inch suction and discharge openings for the main pump and the latter is driven through a flexible coupling by a 300-horse-power motor. The pump delivers 225 cubic yards of solid material per hour through 1,000 feet of discharge pipe to an elevation of 12 feet above water, when running at 345 revolutions per minute. The material in advance of the dredge is cut by a 2-inch hydraulic jet mounted on the bow. Water for this jet, at the rate of 1,300 gallons per minute at a head of 360 feet, is furnished by a pump direct connected to a 200 horse-power motor.

Sterilizing Water With the Electric Spark.—From time to time the SCIENTIFIC AMERICAN has described the use of ultra-violet rays for the sterilization of water. Heretofore the ultra-violet rays have been produced from a quartz-enclosed mercury-vapor arc. Now experiments are being made with an oscillating spark to produce the rays. This is found to be a much more economical system. It is claimed that water sterilization on an industrial scale requires between 45 and 90 watt hours per thousand gallons. In the laboratory, samples of water which are more infected than the water found in industrial practice, require from 200 to 400 watt hours per thousand gallons to produce complete sterilization. One of the particular advantages of using the spark is that the spark may be produced directly in the water, thus eliminating the quartz tube which is responsible for an absorption of as much as 20% of the ultra-violet rays.

First Electric Car in Edinburgh.—According to the *Electrical Review and Western Electrician* up to the present no vehicles driven by electric power have been in use in Edinburgh, Scotland, either for pleasure or business. Now the Edinburgh **Municipal Corporation** has bought an electric vehicle and it is the intention of the committee in charge of the municipal electric plant to encourage the introduction of electric trucks, vans, and other cars. The committee has acquired, through a London agency, an American-built electric lorry or wagon having a carrying capacity of one and a half tons and a guaranteed speed of 11 miles per hour on the level and 5 miles per hour on a gradient of 1 in 10 with full load. The accumulators are of the Edison type. With a full charge, the lorry is capable of traveling 40 miles with a load of one and a half tons and 50 miles with a half load. The control is effected by one handle fixed to the steering wheel, which alters the speed of the motor, so that there are only the controller and brake to operate.

Science

The Coal Mine Insurance Association has recently been organized by ten American and British insurance companies for the joint underwriting of coal-mine accident insurance, and Mr. Herbert M. Wilson, late engineer in charge of the Pittsburgh experiment station of the United States Bureau of Mines, has been appointed director of the association.

A Chemical Hygrometer, said to be much superior to the psychrometer for measuring relative humidity, is described in a recent number of the *Analyst* by Messrs. Rideal and Hannah. The apparatus provides means of determining the moisture content of the air by volume measurements before and after contact with sulphuric acid, which completely absorbs the water vapor present in one contact. A reading can be made in less than two minutes.

Exchange Professorships.—A recent addition to the list of exchange professorship arrangements is reported in *Science*, the institutions in this case being the University of the Philippines and the University of Washington. It is now expected that Dr. Horace G. Byers, professor of chemistry at the University of Washington, will spend the next academic year at Manila, while the head of the department of chemistry at the insular university, Prof. H. G. Deming, will spend the year at the University of Washington (of which he is a graduate).

The Twentieth Anniversary of the New York Botanical Garden in Bronx Park will be celebrated during the week beginning September 6, 1915, and will probably attract botanists from all parts of the United States. In addition to the sessions at the garden, the program includes a visit to Staten Island for a study of the coastal flora, a visit to the pine barrens of New Jersey, under the guidance of the Torrey Botanical Club, a visit to the Brooklyn Botanical Garden, and an excursion to some other point on Long Island.

Mercurial Resistance Standards.—The United States Bureau of Standards has recently constructed four one-ohm mercury standards of resistance in accordance with the specifications adopted by the International Conference on Electrical Units (London, 1908), which defined the international ohm as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross-sectional area and of a length of 106.300 centimeters. Besides the United States, Great Britain, Germany, Japan, France and Russia, now have mercury standards of resistance.

Ducks and Mosquitoes.—A few years ago much was heard about the utility of bats as a means of destroying mosquitoes. According to experiments reported by S. G. Dixon, the most formidable animal enemy of the mosquito is the duck, and the introduction of this bird is recommended for eliminating mosquitoes, and the diseases which these insects spread, from marshy regions where draining would be too costly. Two artificial pools were constructed of equal area, ducks being placed in one and fish in the other. The former pool was quickly freed from mosquito pupæ and larvæ, while in the other they continued to abound. Wild ducks are said to prefer mosquitoes to all other food.

The "Sacred Mushroom" of the Aztecs, which was called by them *teonanacatl* and used as an intoxicant was, according to investigations recently reported by Mr. W. E. Safford, not a mushroom, but the narcotic cactus, *Lophophora Williamsii*, now well known for its use by the American Indians in religious ceremonies. It is popularly called "mescal button," though a better name is *peyote*. Early writers on Mexico described it as a mushroom, and this notion as to its botanical status still survives. The mistake is due to the fact that in one of the two principal forms in which it is prepared the head of the plant is cut off transversely, and when dried it bears a close resemblance to a mushroom. In its other form it is cut longitudinally or in irregular fragments, and was described by early writers as *raiz diabolica*, or "devil's root."

Meteorological Isograms.—The family of curves so widely used in meteorology under the name of "isograms" is steadily increasing. It is just a hundred years since the earliest of the meteorological isograms, the isotherm, was described by Humboldt, who actually published a map of isotherms for the globe two years later in 1817. At the present day the isotherm, the isobar, and a few others are generally familiar; but there are numerous others, with the very names of which even the average professional meteorologist is scarcely acquainted. The first comprehensive description and enumeration of these lines was that published by Mr. Fitzhugh Talman in the SCIENTIFIC AMERICAN SUPPLEMENT of November 12, 1910. In the last number of the *Monthly Weather Review* the same writer publishes a list of isograms, in which are included all that have been introduced since the earlier article was written, as well as some of earlier date which were omitted from that article. About ninety names of isograms are defined.

Inventions

An Amusement Doll.—William B. Choate of Aurora, Ill., in patent No. 1,143,808 presents an ingenious device which can be applied to the clenched hand and has eye portions, nose and mouth portions and material simulating hair which produces a face-like effect, the fingers and end of the thumb co-operating in securing the result.

A Life Saving Tube on a Waistcoat.—In patent No. 1,143,899, issued to James W. Gieve of London, England, assignor to a Portsmouth firm, is provided a life saving garment in the form of a waistcoat having incorporated therein a life saving belt which encircles the wearer and which can be blown up whenever desired, being so that it will not normally present any unsightly appearance. The tube has its larger portion extending around the chest of the wearer so that when in the water the upper portion of the body and head will be thrown backward.

Match Box, Etc.—A special form of box in metal, wood or cardboard is employed in Europe for holding long objects such as matches, toothpicks, cigarettes and the like, especially for pocket use. Seen in section, the box has a somewhat triangular shape, and the point of the triangle is formed of the junction of two edges or lips; these have a natural spring action which tends to keep them closed, but by pressing on the ends of the box they can be forced open and the match, etc., can be removed. On this edge is a half-round cutting which allows the fingers to seize the object and withdraw it from the box.

Rubber Bulbs.—Common methods for making large pear-shaped rubber bulbs provided with celluloid or other nozzle, for handling liquids, have various drawbacks which are avoided in the present makeup. It often happens that refilling is done by suction through the same nozzle, which takes time, and is subject to a clogging up. Here the refilling is very quickly done by making the bulb with the top end fully open by the use of a large screw cap at this end. On unscrewing the cap along with its nozzle, the bulb can now be filled up in the same way as a bottle, which saves much time, and again the bulb is easily cleaned.

Double Key.—This invention is designed to make two keys in one, in order to lessen the number of keys carried in the pocket. Were we to cut two keys and place end to end, a double key would be secured, and in practice this is carried out by using a single key rod with double ends, each end thus giving a separate key. In order to afford the required grasp for the hand, each end portion is surrounded by a ring of rather square shape or conforming to the key end. This ring pivots upon a small collar that is put on the key rod just back of the end portion, and when used for a hand grasp, the ring lies in the same plane, but on the other end the ring is swung back so as to insert the key in the lock.

Writing or Drawing Tablet.—A new tablet introduced in Europe uses ink, pencil or chalk, and is easy to rub out, while it is unbreakable and hence better than a slate, etc. Stiff cardboard serves as the backing, and on it is spread a coat made of a mixture of waterproof shellac and anhydrous silicic acid in fine powder; e. g., fine sand can be used as this material. As the coating is not opaque, the background can be of white or colored paper, or painted, etc., and can carry lines or designs. The coating, however, can be colored by the addition of any suitable substance. Such board can be framed like a slate or can be used alone, with a proper treatment of the edges. Coating can be written upon and this effaced, until it is entirely used up, and lasts a long time.

Desk Blotter.—In the common type of desk blotter consisting of assembled pieces of blotting paper between two flat wood pieces and provided with a handle, a French patent makes use of an improvement which avoids the use of a screw thread such as is commonly used for the knob which serves to screw the flat piece upon the lower piece. Both pieces can be of wood or metal, etc., and the top piece has on the under side a tongue (integral, if in metal) which passes clear through the lower piece so as to project on the under side, and here it can be fixed by passing a small wedge through a square hole in the tongue. This clamps the two pieces together, with the blotting paper in place, and the blotter takes the usual curved shape below. Suitable means are provided for keeping the wedge in place.

Umbrella Device.—The following is a recently patented device for putting name and address upon an umbrella. Writing is done on a narrow strip of paper, and the paper is then rolled around a pin of small diameter which carries a suitable head in order to be screwed or otherwise fitted into the end of a tubular socket, allowing the pin to be inserted into the closed tube and held there. The paper with name and address is thus quite protected. Means are provided for attaching the small tube to one of the ribs of the umbrella, in the shape of a suitable spring clamp which grasps the rib as well as the tube and thus secures it in place. Such a device is removable, and also allows of changing the name and address easily.

Fuel Oil for Locomotives

Its Study Offers Problems That Are Not Met With in Other Fire Feeds

LOCOMOTIVES fired with oil are practically unknown in the eastern and central portions of the United States, but on the Pacific Coast, where a plentiful supply of suitable oil is readily obtainable at low prices, and across the southern portion of the country through Texas, where the same conditions prevail, the greater portion of the locomotives are operated on this fuel. The subject of oil fuel was discussed at the convention of the International Railway Fuel Association this spring, on which occasion Mr. G. M. Bean presented the following interesting comments summing up modern practice:

From 1907 to 1914 the use of fuel oil by railroads increased 112 per cent when a total of 31,000 miles, distributed over 50 railways, were operated with this fuel. A study of the use of fuel oil in the locomotive furnace is extremely interesting, because it offers problems that are not met with in other fuels.

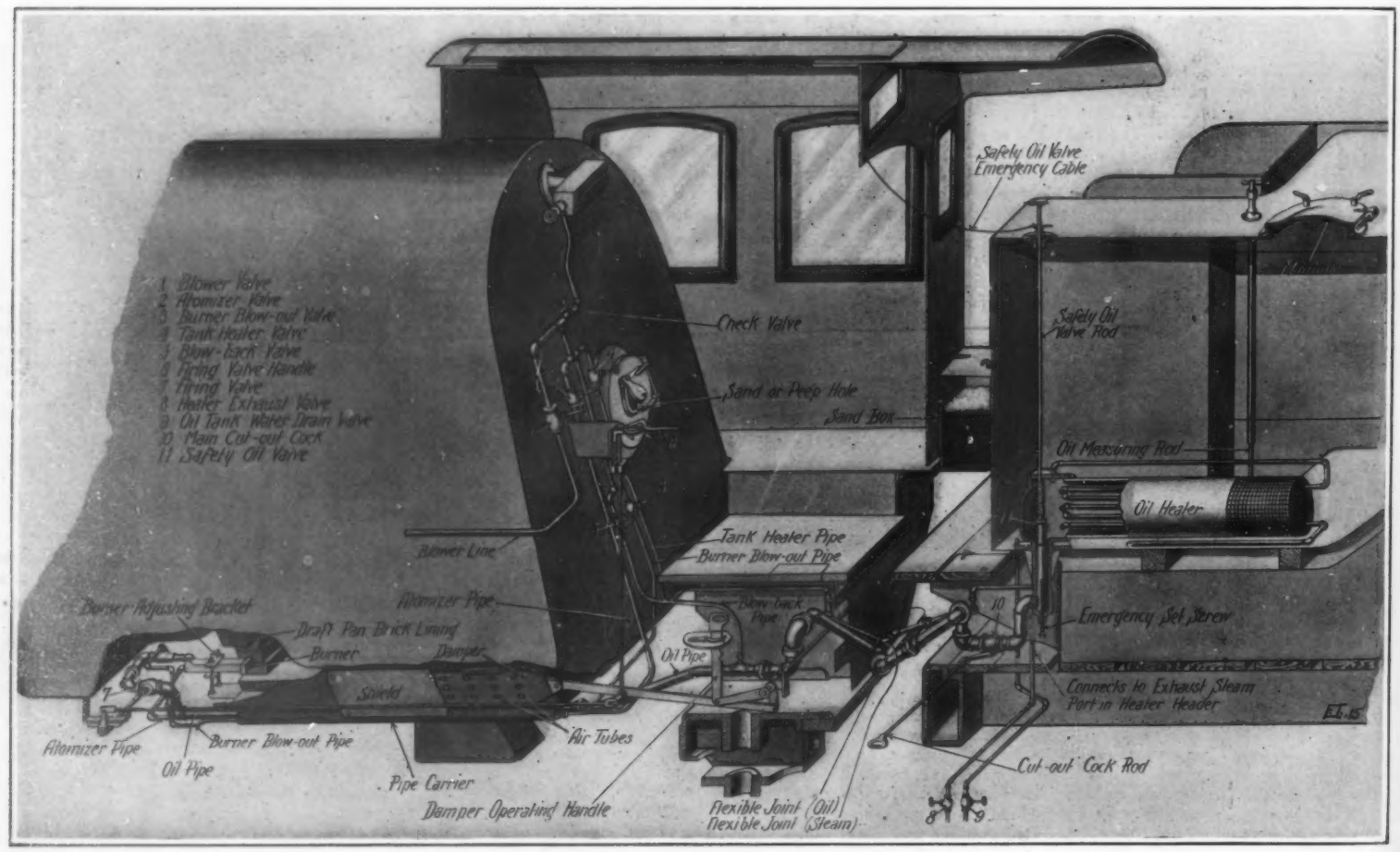
With liquid fuel the diffusion must be simultaneous with ignition, with the resultant long flame, and a large furnace volume is essential. While the relative dimensions are of minor import to the volume, it is evident that a flame passage of sufficient length must be provided to prevent unconsumed particles passing to the flues. While it is generally conceded that lack of oxygen is responsible for smoke, the writer believes that restricted furnace volume and the attending lack of time for the proper mixture of the gases in the more highly heated portion of the furnace is the most common cause for black smoke from an oil-burning locomotive. Special attention is directed to this point in connection with locomotive oil-burner furnace design because of the general tendency to restrict the furnace volume by carrying the draft pan and brick work too high in the fire-box covering up valuable heating surface and bringing about the continual necessity for forcing the fire at the expense of the remaining exposed surfaces.

At the first inception of the idea of using oil in this country the burner was placed under the rear of the firebox and directed forward with an upward incline so that the flame shot under a low, short brick arch, with the result that combustion became so intense in this limited space as to cause the flame to pass from under the arch with such velocity as to impinge on the door sheet, side sheets, and crown sheet, with very detrimental results. The burner is now placed in the front end of the draft pan and directed toward the rear in such a manner that the draft is forced to reverse the direction of the flame before it passes to the flues. The furnace is open, the brick work kept low and the maximum of heating surface is exposed.

The proper maintenance of brick work is essential to good results, and the possibility of the brick work falling down in the path of the flame must be avoided, as it usually results in an engine failure.

The oil supply is carried in tanks built to fill the coal space of the tender, and piped from there through suitable connections to the burner. It is generally necessary to provide means for heating the oil so as to insure a proper flow, as gravity is depended on for the necessary pressure. It is probable that the box heater is the most desirable arrangement. It is indirect in its action, only heating a sufficient volume to insure a supply at the burner, and is not liable to cause trouble by allowing water to get into the oil storage.

The illustration shows in detail the general arrangement of oil burner equipment which represents the latest standard practice as applied to locomotives of the Atchison, Topeka & Santa Fé, and is probably as complete and efficient as any so far devised. The indirect heater, together with the large direct oil supply line from oil tank to burner, insures ability to handle the heaviest of oils. The special attention of those interested in the subject of efficiency of oil burner handling and equipment, is called to the necessity for careful supervision of all locomotive equipment and care not to abuse the privilege of having oil burner power to handle trains by overloading at the ultimate expense of fireboxes and flues. Emphasis should be placed on the fact that the oil fireman is a large factor in the success of the operation of oil burning locomotives. He must intelligently follow every movement of the engineer that demands regulation of the fire.



How an oil-burning locomotive is constructed.

Fresh Air and Eating

THE New York Commission on Ventilation has recently made a report on one more phase of the investigation which they have been carrying on with so much thoroughness for the past two years. Their earlier work shows that people can remain in an unventilated room for several hours without there being any direct effect upon the pulse, blood pressure, body temperature, respiration or metabolism, *provided the temperature of the room is kept down.* Their latest results, however, show that lack of ventilation very decidedly influences us in a way in which most of us certainly do not want it to, namely, in our desire to eat.

In order to carry on this part of the general study the commission divided the number of people on whom the experiments were conducted into five groups, only one group being under investigation at a time. Those in the first three groups were young men and those in the last two, young women. Each group of these scientific aids remained in the room, which is used in all the ventilation experiments, for a period of several hours, five days a week, for several weeks. On half of the days the room was well ventilated. On the other half there was no ventilation. On all occasions the temperature and humidity were controlled so that they were the same throughout the experiment.

After the people had been in the room for a period of from two to three hours each day a luncheon was served to them. How tempting a meal was placed before them the commission fails to report. Neither do they record whether individual idiosyncrasies were favored, but without doubt the menu was first class. All food was weighed and its value in calories recorded before each meal. What was left over was again valuated. In all, something over 500 meals were eaten, one half of them in fresh air and the other half in vitiated air, with the result that on "unventilated days" less food was consumed than on "fresh air days." Furthermore, the records indicated that the effect of vitiated air upon the appetite increased the longer the experiment continued.

The Travel of a Balance Wheel

IN a recent number of *Prometheus* a contributor summarizes the following interesting data about the balance wheel of a watch:

The balance wheel of a large watch has a diameter of about 0.75 inch, and a circumference of 2.36 inches. As the wheel makes 5 single oscillations in a second and the amplitude of each oscillation is 1.5 complete revolutions, the rim travels about 18 inches in a second, one mile in an hour, and 24 miles in a day. In three years of uninterrupted running, which is not unusual, the travel of the rim of the balance wheel equals or exceeds the circumference of the earth, a distance that a locomotive, running 10 hours daily at a speed of 30 miles per hour, would take nearly three months to accomplish.

Dispersing Asphyxiating Gases

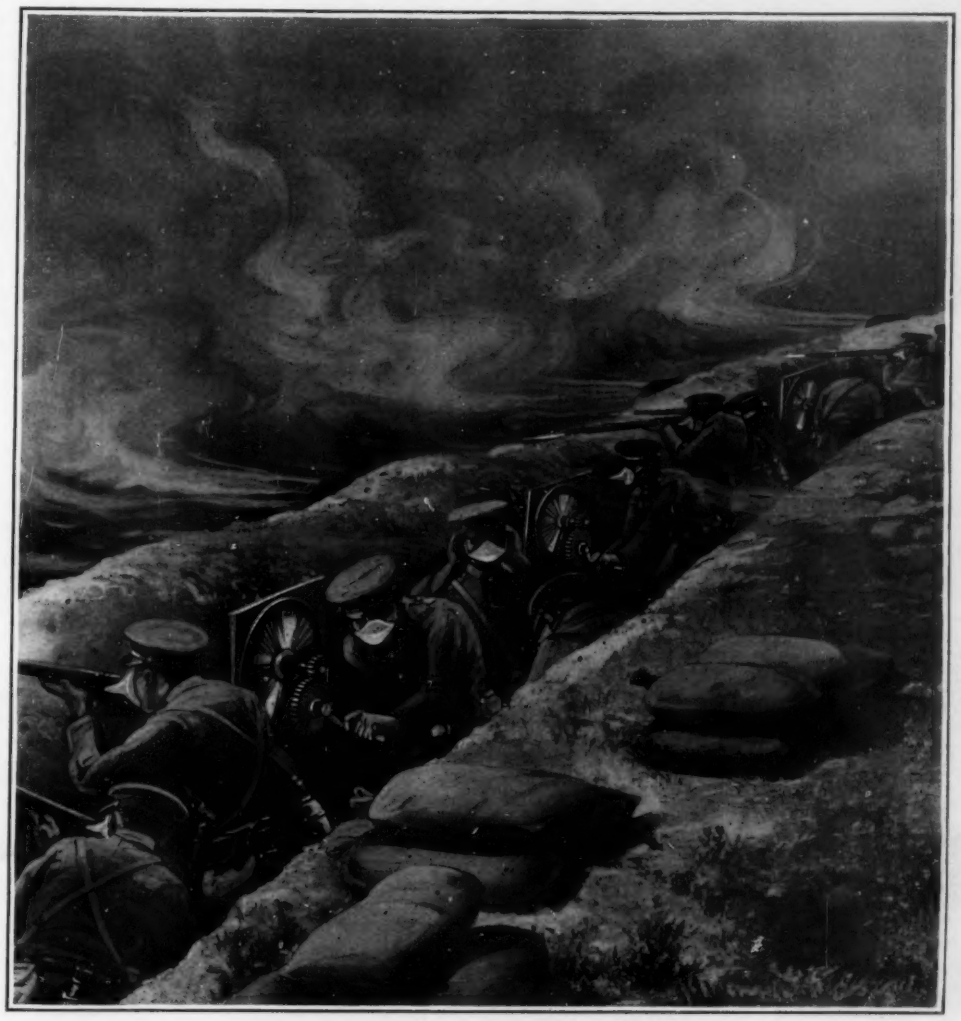
A SUGGESTION has been made by a writer in the *Morning Post*, London, that asphyxiating gases may be dispersed, and rendered innocuous, by means of fan-blowers; and in commenting on this idea *Nature* says:

"He proposes the use, in the trenches near enough to the enemy to be in danger from such gases, of rotary fan-blowers worked by hand placed at about every three or four yards. The fan-blowers should be connected with pipes going through the base of the earthwork in front of the trench. If the number of blowers were equal to the number of gas cylinders used by the enemy, the blowers when vigorously worked would deliver a far greater volume of air than the volume of the poisonous gas, so that the gas would become much diluted, and with good respirators would be harmless to our men. We believe that experiments are being conducted at the front with the object of devising means to render the poisonous gases innocuous by spraying with water and in other ways. The former expedient would require only a supply of water in the trenches and a spraying apparatus, and it would seem to afford an effective means of protection."

In a recent article in the SCIENTIFIC AMERICAN this same idea was brought forward:

"The only practical method of meeting these gas attacks, apart from the use of respirators charged with absorbing chemicals, such as bicarbonate of soda and similar alkaline salts, would appear to be that of creating a counter air current, which would either roll the gases back, or would lift the clouds of poisonous vapor as it drifted clear over the trenches of the Allies. It might be possible with the aid of the army engineers to adapt the engines and propellers of aeroplanes for this work, or to arrange for gasoline operated air pumps to be stationed at certain points in the lines most subject to these gas attacks. These attacks, it must be noted, are only delivered when a light breeze from the north and northeast favors the German design. A slight counter air current ought to suffice, therefore, to deflect the direction of the gas cloud as it slowly drifts over the ground between the two lines of trenches, and even if only certain selected portions of the allied trenches could be kept free from the gases in this way, they would serve to act as a rendezvous for the men engaged in the defense of the position.

"These anti-gas fans and pumps, of course, would have to be well hidden and protected from German observation, otherwise they would soon be located and smashed by the enemies' fire. Placed in small 'dug outs' at the rear of the first line trenches and connected with these by underground ducts or flexible hose-pipe, they should, however, prove of great service in repelling attacks of poisonous vapor."



Fans to disperse asphyxiating gases.

The Range of a Quick-firing Field Gun

QUICK-FIRING field guns, using either shrapnel or high explosive shells, have played a prominent part in the military operations abroad, and the accuracy and efficiency of their work has reached a high degree of perfection. The published reports often speak of the use of shrapnel shells, but those of the high explosive type, that depend for their results on the violence of the explosion of the charge they carry, and the scattering of the fragments of the body of the shell, instead of the scattering of large number of bullets, are also being largely used.

In field operations the range, or distance of the enemy's position, is first approximately obtained by means of some form of range-finding instrument, and a trial shot is fired. The point where this shell explodes is noted by an observer from some elevated position, or, as is frequently the case, the observation is made from an aeroplane and signaled to the gunners. The latter method is the most accurate, for the aviator can fly directly over the trenches of the enemy and pick the most advantageous point to be aimed at. From the reports of the observers the proper corrections are made in the aiming and elevation of the gun and the attack continued.

The American 3-inch quick-firing gun has an effective range of 6,000 yards. This is clearly indicated in the accompanying diagram, which recently appeared in *Machinery*. From it we see that a shell fired from such a gun starts at a speed of 1,700 feet per second and covers the distance in 19.36 seconds, and is still traveling at a speed of 740 feet per second when it reaches its goal. The times of flight and terminal velocities for shorter ranges are clearly shown in the diagram.

When a shrapnel shell explodes the bullets it contains are shot out at an increased velocity of about 250 to 300 feet a second, covering an area of about 250 by 30 yards, half the bullets falling on the first fifty yards of the beaten zone. In some cases the explosion of the shell is caused by a percussion fuse placed in the point of the shell, which operates when the shell strikes any solid object; but usually a time fuse is employed. This is an ingenious device that can be set to explode the shell at a given definite interval after the shell leaves the gun, the firing of which ignites the powder in the fuse through an opening in the point of the shell. The range being known, tables show the exact time the shell will require to reach its destination. A finely graduated scale marked on the timing fuse in the point of the shell enables the gunners to instantly adjust the fuse so that it will operate immediately the shell arrives at its target, and thus avoid the uncertainty that sometimes occurs when a percussion fuse is used.

In the illustration, for the sake of clearness, the gun is drawn larger than its correct proportions to the rest of the diagram.

Protecting the Oysters

FOR several years the oyster planters of Delaware Bay have suffered considerable losses from the depredations of the drum fish, or channel bass, which have been frequenting the neighborhood in great numbers, and which crush the shells and suck out the young oysters to such an extent as to threaten the extermination of the oyster beds. To meet this difficulty some bright genius has produced a simple device that, for want of a better name, may be called a marine "scarecrow." This consists of a shingle attached to a piece of copper wire, by which it is anchored to the bottom of the oyster beds by a small weight. The short length of wire allows the shingle to swing over quite an area, while the tide or currents give the shingle a whirling motion that frightens the fish. Large numbers of these whirlers have been planted in the coves, and are said to be very effective.

Fire From Slaked Lime

WOOD can catch fire from the slaking of even poorer grades of lime. Very poor limes may produce a temperature of 300 deg. Cent., which is sufficient to char the wood on exposure to air. The best limes can produce a slaking temperature of 400 deg. Cent. so it is dangerous to ship them in contact with wood.

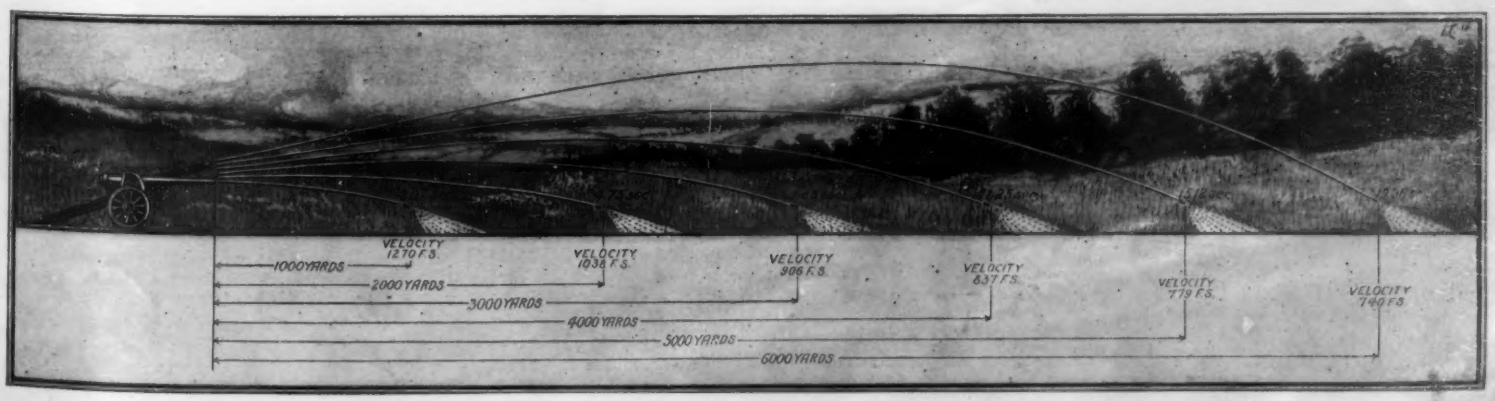


Diagram illustrating path of a shrapnel and the time of explosion at various distances.

Strategic Moves of the War—July 21st, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

THE German Steam Roller is again in motion, and more than ever before during the two and a half months the Russian campaign has continued, it promises to crush everything before it. The machine is well oiled, and if we may judge by past performances of the Germans, every contingency has been foreseen and all arrangements have been made to keep it in motion until Warsaw and its nearby protecting fortifications have been captured.

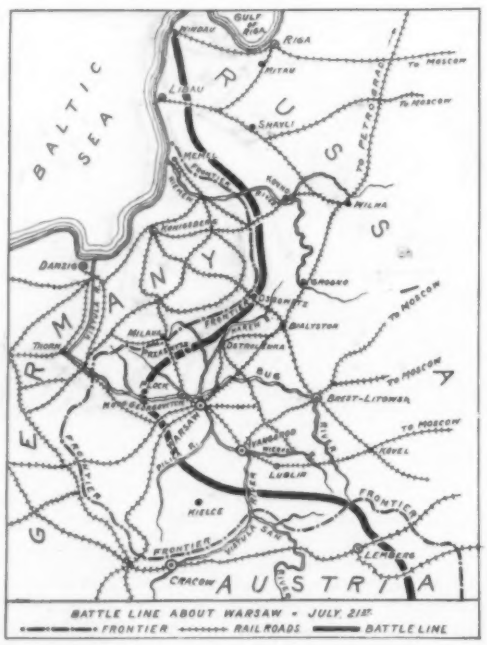
A week ago the world was waiting for the significant events that would indicate the future plans of the Teutons, and it was pointed out in these notes at that time that a broad view of the whole situation in all theaters of war pointed fairly definitely to a continuance of the campaign in Rassia until Warsaw had fallen and the Russian army had been struck a blow from which it could not speedily recover. It was also pointed out that extensive re-arrangements of the German forces probably were being made with the idea of striking Warsaw from the north and west. The developments of the last few days have lifted the "fog of war," which the Germans succeeded in spreading for a brief period over the extensive battlefield, and have revealed operations which appear to confirm the correctness of last week's assumptions.

The armies of the veteran Field Marshal von Hindenburg are again in action, and he is now sharing in the honors which for some weeks have been fairly monopolized by the other great German leader, von Mackensen, who has won his field marshal's baton in this war. In the closing months of last year von Hindenburg's masterful leadership cleared East Prussia of the Russian invader and won for him such renown that he fairly rivaled the Kaiser in popularity. More than once his army was at the very gates of Warsaw, only to be stopped because of lack of successful co-operation by the other Teuton armies farther to the south in the eastern theater. Finally, in December, his last drive at Warsaw was stopped about twenty-five miles west of that city, and from that time until fairly recently, the Polish capital has not been seriously threatened.

For nearly seven months von Hindenburg has been playing a minor rôle in the great tragedy. Like the combatants on the western front, his army burrowed into secure positions and waited for the time when it would again be called on for offensive action. By way of mystifying the Russians, occasional advances were attempted, but never in great force, and never with any lasting success of importance. There was one exception—his advance into the Baltic provinces to the north as far as the Gulf of Riga, by which he has gained a secure foothold in a strategic position on the Russian flank which may be of incalculable value before the close of the operations just beginning. The capture of Libau some months ago and the occupation of the region about the Gulf of Riga, made more complete by the capture this week of Windau, is another illustration of the far-seeing thoroughness of the strategic planning of the German General Staff.

Now it looks as though von Hindenburg's patience is to be rewarded by giving to him the lion's share in the capture of Warsaw, the prize at which he has aimed for nearly a year. A little study of the map will make clear the reason for this statement. The territory of Russian Poland extends like a huge bastion or salient into German and Austrian territory. A line from Ossowetz through Brest-Litovsk would mark the eastern limit of the bastion, which measures about three hundred miles from east to west and nearly the same distance from north to south. If Russia's early offensive campaign against Germany had succeeded, the bastion would have been of decided advantage to her, but against the German invasion of Russia, as the battle lines have developed, it is an element of weakness, for the same reasons that a narrow salient in a limited section of a battle line is an element of weakness. Russia must do all she can to protect her Polish territory, and with this in view she constructed powerful fortifications at Warsaw, Ivangorod, Novo-Georgovitch, Przasnysz and elsewhere within the bastion. The natural desire to defend these strong places has increased still further the tendency to hold on to this territory, and while Russia has given ground steadily on the portions of her battle front to the north and south of Poland, she has maintained her old position within the bastion itself. It is not possible to say to what exent this has resulted from crafty German planning, but it must be admitted that the German advance was of a character to bring about the very situation that exists to-day. The drive through Galicia steadily pushed back the Russian southern wing, all the time bending a part of the Russian center like a bow about Warsaw to the south, while the operations of von Hindenburg on the Russian northern wing were holding the bow in place west of Warsaw, and bending it still closer about that city to the north.

The time to break the bow has now come. This is to be done by the simple process of increasing the pressure on its two extremities until it of necessity must give way at some point. Von Mackensen, between the Vistula and Bug rivers, is pressing against its southern end, while von Hindenburg from Ossowitz to Plock is pressing against its northern end. Because of the more advantageous railroad situation in the north, as fully explained in these notes last week, the blow which, if successful, will isolate Warsaw and clear Poland of the Russian army, most probably will be struck from the north. Field Marshal von Mackensen must bring all his supplies from the Cracow-Lemberg railroad, nearly one hundred miles in his rear, and even with the most perfect automobile transportation it would be next to impossible to furnish the vast quantities of ammunition necessary for a sustained advance against field works and permanent fortifications. Still, during the week just ended the German armies on this front have done extremely hard fighting, much to the surprise of an observing world, and have made material gains between the Bug and Vistula rivers. This offensive, no doubt, has for its immediate objective the Ivangorod-Lublin-Kovel railroad, not because this would be of any immediate benefit to the Germans, for it has no terminus



The battle line about Warsaw on July 21st, 1915.

within German territory, but because it is of great benefit to the Russian line south of and parallel to it. If Field Marshal von Mackensen can deprive the Russians of this railroad, he may then intrench his position, and by acting on the defensive bring up sufficient ammunition to hold it as an anvil against which the powerful hammer of von Hindenburg in the north can crush the Russians in his front.

Field Marshal von Hindenburg has no doubt been greatly re-enforced by withdrawing troops from other portions of the German front, or by new troops from Germany. The Teutons are continually calling new troops to the colors and training them for active service. So far as is known, they have not been forced to send any considerable numbers of them to the front before they were perfectly trained and equipped. Reports indicate that they are just completing the training of a contingent of about eighteen corps, or more than half a million men, and that they are available for this climax of the Russian campaign. It was about a week ago (July 14th) that the daily bulletins from the various headquarters indicated the beginning of unusual activity by von Hindenburg's force, but it probably was in motion some days before that. From that day until now (July 21st) fighting has increased in intensity on the hundred and fifty mile front from Ossowetz to Plock. Przasnysz has been captured again by the Germans, and the fortress at Ossowetz is under continual bombardment. The drive is in full swing and promises to be as irresistible as the earlier one through Galicia.

Now what is the probable action of the Russian leader if he cannot stop the German advance north and south of Warsaw? The circle is closing about that city, its outlying protecting fortifications, and the hundreds of thousands of Russian soldiers within this area. From one extremity of this swinging arc near Ossowetz to the other near Lublin the distance is but two hundred miles—already a narrow gap through which to withdraw the Russian army, should withdrawal be necessary. The pincers which threaten to tear all Poland from Russia are gradually closing their jaws in front of Brest-Litovsk. It would be difficult to imagine a commander in a more trying position than that confronting the Grand Duke. Should he decide to hold on to the lines about Warsaw, in the belief that he could stem the German tide, and should he fail, the disaster would be greater than any the Russian arms have yet suffered. Should he decide to abandon the territory within the closing circle of Germans, not only would the sacrifice be great, but the withdrawal would be a most hazardous operation. From Plock, the most westerly point of the Russian line, it is two hundred miles to the fortifications of Brest-Litovsk, where the retreating Russians might find sufficient support and protection to make a determined stand. Under most favorable circumstances this distance could not be covered in much less than two weeks, and for this period the advancing German wings must be held back to admit of the safe withdrawal of the Russian troops about Warsaw. For the removal of the large quantities of military supplies, doubtless collected in this area, but two railroads are available, both of which are seriously threatened. In short, all the dangers and difficulties of withdrawing from a strongly held salient are present.

Judging from the past performances of the Grand Duke, this great leader in retreat, we may feel fairly confident that he will avoid one thing of prime importance—the division of his army. He may have to sacrifice valuable territory, strong strategic points, many men and much war material, and even so suffer no greater disaster than has been predicted often during the past few weeks. But he certainly will not fail to rob the Germans of the decisive victory they would secure if they should divide the Russian army. For more than two months this has been the aim of German strategy, successfully foiled by the consummate skill of the Grand Duke; but his leadership is to be put to a more severe test than ever before. By abandoning Poland and withdrawing to a new position along the Bug River he will straighten his entire line, which will then occupy strong defensive ground throughout its entire length of approximately one thousand miles. The southern wing will be protected by the Dniester River and its northern tributaries; the center wing by the Bug River and the powerful fortifications of Brest-Litovsk; and the northern wing by the Niemen River. Safely established along this line, he can force the Germans to undertake a new series of operations, preliminary preparations for which would require much time that might permit the re-establishment of an adequate supply of ammunition from the interior of Russia.

Such a position, however, might be turned by a German advance from the region of the Gulf of Riga. The German operations here have been making good progress, and the position is one of great strategic value to them. Events only will show whether they have the troops, material and energy left after the Warsaw campaign to inaugurate and carry through a new drive from the vicinity of Riga against the Russian extreme right.

Safe Railroad Travel

RECORDS just closed for the year ending June 30th, show that in that period the Pennsylvania Railroad System carried approximately 180,000,000 passengers and not one was killed in a train accident.

These records cover the entire system, with its more than 26,000 miles of track, located in thirteen States, including the lines east of Pittsburgh, the Long Island Railroad, the Cumberland Valley Railroad, the New York, Philadelphia & Norfolk Railroad, the Baltimore, Chesapeake & Atlantic Railway, the Maryland, Delaware & Virginia Railway, the lines west of Pittsburgh, the Vandalia Railroad, and the Grand Rapids & Indiana Railway. The Pennsylvania system operates some 113,000 passenger trains every month.

On the lines east of Pittsburgh and Erie, consisting of the Pennsylvania, the Philadelphia, Baltimore & Washington, and the West Jersey & Seashore Railroad, not a single one of more than 265,000,000 passengers carried in the past two years and a half has been killed in a train accident. The last train accident in which a passenger was killed occurred at Glen Loch, Pa., in November, 1912.

Adding Electric Power to a Railroad

BETWEEN the Broad Street Station and the West Philadelphia yards of the Pennsylvania Railway there are no less than 2,295 train and engine movements every day, and this was found to so tax the capacity of the Philadelphia terminal that it was impossible to handle any additional trains to meet increasing traffic. A careful study of the situation was made with a view to effecting the quickest relief, and it was concluded that this could be best secured by operating a portion of the heavy suburban traffic by electric power. Steps were, therefore, at once taken to equip the road for this power as far as Paoli, a distance of twenty miles.

This work involved the stringing and restringing of 660 miles of electric wire and the erection of 760 poles and 36 signal bridges, together with the necessary power stations. To do this work, especially the stringing of the wires, above tracks on which such an enormous traffic was constantly moving, without causing interruptions, was a most difficult task, but it has been accomplished without a single accident.

An overhead system of power distribution was decided upon, instead of employing a third rail, because it was considered to be better adapted to the operation of complicated yards, and also because it would adapt itself more readily to any extensions that might be desired in the future; and in designing the system, instead of the simple form of trolley wire ordinarily seen, an improved catenary system was adopted. A "catenary," as known in mathematics, is the curve taken by a rope or wire when hung between two supports, for no matter how tightly such a wire may be stretched it cannot be pulled perfectly straight, but hangs in a constantly diminishing curve from the support to the middle of the span. As designed for the present installation a heavy catenary wire is strung between the supports, and from this the trolley contact wire is suspended by supports varying in length at different points in the span, the longest supports being those nearest to the poles, so that the trolley wire is supported exactly level at all points.

The trolley wire used here is of a double construction. The upper wire, which is hung directly from the catenary, as above described, is of a heavy copper and suspended from this, by clips about two inches long, is the contact wire, which is shaped in section like a figure 8, made of a hard alloy that will withstand wear. The suspending clips grip this contact wire in the grooves in the sides, leaving the under contact side smooth and clear to the trolley on the car.

It will be appreciated that placing such a maze of wires in position over the tracks of a busy steam road for a distance of twenty miles was a difficult undertaking, and many devices had to be resorted to in performing the work. The front page illustration shows one of the actual situations and gives an idea of how the conditions were met.

This electric service will not be applied to the through trains using the station, but only to the numerous suburban trains on the western division, but this will reduce the number of train movements in the station by 15 per cent, and all of the double movements that are necessary when steam locomotives are used will be eliminated. Further relief, or the possibility of accommodating additional trains, will be made possible by an extension of this electric system on the western division of the road, and by the electrification of the divisions running north and south from this station.

The Current Supplement

IN the current SUPPLEMENT of the SCIENTIFIC AMERICAN will be found an interesting account of explorations made of Babylon the Great, with numerous attractive illustrations. The enthusiast in amateur wireless telegraphy will be pleased with the description of a multiple tuner, complete working drawings and specifications for which are here given. The method of making a continuous drop attachment for a thermos bottle for irrigation purposes will be of value to many scientists. The science of medicine interests most everyone, and the exhaustive study of the medicines mentioned in the Old Testament throws a valuable light on ancient medical practice, as well as on the history of medicine generally. Lime burning gives many valuable suggestions on a practical industry. The uniflow steam engine has aroused widespread interest, and the article in this issue of the SUPPLEMENT adds considerable information on the subject. To those who take pleasure in mechanical problems the illustrated article setting forth some of the properties of articulated levers will open a new line of thought and suggest methods for obtaining many curious and unusual movements. The article on apple syrup and concentrated cider is a valuable description of the possibilities of a new industry that will enable our surplus and hitherto wasted apples to be utilized. Giant artillery of fifty years ago gives many facts that are interesting for comparison with modern practice. The valuable article on recent progress in astrophysics is concluded in this issue. Some of the features of that interesting physico-chemical problem, isotopy, are considered in a short but valuable article in which some late facts are collected. Geology in relation to the exact sciences is another of the interesting articles showing the widely related value of geology to science which has been considered in several previous papers.

Loss of Zeppelins

THE Italian naval authorities, through their official organ, have compiled the following tables (reprinted here from *Aeronautics*) relating, first, to the loss of craft—excluding, of course, the two airships recently destroyed by British aviators—since the beginning of the war, and their successful raids.

ZEPPELINS LOST

	Date	Place
1	August 6, 1914	Liege
2	August 6, 1914	Between Hemexin and Antwerp
3	August 20, 1914	Badonviller
4	August 20, 1914	Grandviller*
5	September, 1914	Luxemburg*
6	September 6, 1914	Serodz
7	October 14, 1914	Warsaw†
8	January 25, 1915	Libau
9	February 18, 1915	Isle of Faroe‡
10	February 18, 1915	Isle of Faroe

* These two entries probably refer to the same occurrence.

† In all probability this airship was a Parseval, or belonged to the "M" type.

‡ The last two dirigibles were naval Zeppelins of the latest type, both stranded on the Danish coast as the result of a sudden snow squall.

It may be added that, in default of more precise knowledge, the above table is obviously based on newspaper reports, and cannot, therefore, be accepted as reliable, although, in the early stages of the war, Italy probably had a better opportunity of obtaining accurate knowledge than any belligerent or even any other neutral. The only Zeppelin losses, apart from those in the last two months, which are amply substantiated, are those which occurred on August 20th at Badonviller and on February 18th off the coast of Denmark.

On the other hand, the same authoritative source states that, until the end of February, Zeppelins carried out the following attacks:

	Date	Place	Bombs Dropped	Results
1	August 24, 1914	Antwerp	6	12 killed
2	September 24, 1914	Ostend	3	Material damage
3	September 25, 1914	Ghent	6	1 killed
4	September 28, 1914	Warsaw	3	3 soldiers struck
5	September, 1914	Bielostock	3	11 children killed
6	October 1, 1914	Antwerp	3	Material damage
7	November 22, 1914	Cuxhaven‖	—	———
8	December 9, 1914	Warsaw	18	40 killed, 50 wounded
9	December 26, 1914	Nancy	14	2 killed, 2 wounded

‖ During the raid on Cuxhaven by our aeroplane squadron, two Zeppelins appeared and were soon put to flight by the fire of our ships.

According to these figures, some of which obviously refer to Parsevals, the German airship fleet, therefore, in seven months of warfare, accounted for 86 killed and 56 wounded, practically all of whom were civilians and the majority women and children. We reproduce this table mainly for the reason that it came from what was then a neutral source. Nothing could more effectually deal with prevalent illusions regarding the so-called Zeppelin danger. Not that a Zeppelin, if properly handled for war purposes alone, could not render military service of enormous value. Had we possessed a fleet of these craft at the outbreak of war, we would at any rate have made our presence felt effectively in the military sense. As it is, we must wait and see. The Germans certainly do not hold all the trump cards.

Carnotite and the Bureau of Mines

THE Bureau of Mines has recently published a bulletin "Technical Paper 88," by S. C. Lind and C. F. Whittemore on the Radium-Uranium Ratio in Carnotite, which reports the results of one of the recent investigations undertaken by the Bureau in its constant endeavor to increase efficiency in the mining and treatment of the national mineral resources. The bulletin in question relates to the methods of lessening waste in the extraction of radium from the carnotite and other uranium bearing minerals of Colorado and Utah and is a comprehensive technical treatment of the important subject, which should be carefully studied by those immediately connected with the industry, not only because of its technical interest, but also because of its bearing on the commercial side in the aid it suggests in determining the real value of any particular mineral in a purchase and sale transaction.

Utilization of Peach Seeds

AT one fruit canning plant in California a thousand tons of peach seeds were accumulated last season. They were cracked by special machinery, and the meats shipped to Germany, where they were used in the manufacture of prussic acid and some other products. The meats were also processed by the Germans to make the bitter almonds of commerce. The canning company sold the shells as fuel.

Correspondence

[The editors are not responsible for statements made in the correspondence columns. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Swat the Fly Eggs

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 19th there appears an article, "Swat the Fly Eggs," in which you state that Dr. Howard's advice is to apply six to ten pounds of borax to every eight bushels of manure. This should be six-tenths of one pound, or roughly, ten ounces to eight bushels of manure, as we have figured it in the inclosed circular.

PACIFIC COAST BORAX COMPANY,
Chicago, Ill. H. DESMOND, *Manager.*

Vacuum Gasoline Feed for Automobiles

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of May 15th a letter of E. Paul Du Pont relative to "Vacuum Gasoline Feed for Automobiles," and calling our attention to an error which appeared in an article of your issue of April 24th, relative to the fact that "no pressure system could possibly force gasoline to the carbureter when the car was at this angle."

Mr. Du Pont's article is correct in so far as theoretical facts are concerned, but probably no pressure system on an "automobile has ever been found to hold air and so work absolutely automatically. Before you can start the motor, the chances are, ninety-nine times out of a hundred, that there is no gasoline to the carbureter, and it becomes necessary to hand pump air pressure into your gasoline system, so as to force gasoline to the carbureter.

Mr. Du Pont states that the usual pressure system "maintains" two pounds. But the fact remains that many pressure systems "maintain" anywhere from no pressure at all (before starting the car, and often whenever going up the slightest grade), all the way up to more than three or four pounds (after the car is running). That's the trouble and nuisance—you never know where your pressure is, nor whether you have any at all, or not.

Had the line in your article which Mr. Du Pont objected to been changed so as to admit of the four words, "be depended upon to," then you would have stated the matter exactly, and it would have read, "At this angle no pressure system could possibly *be depended upon to* force gasoline to the carbureter." Of course, Mr. Du Pont was arguing upon engineering facts, while you were treating of the matter from the standpoint of experience. And anyone who has ever driven cars having pressure feed systems knows that.

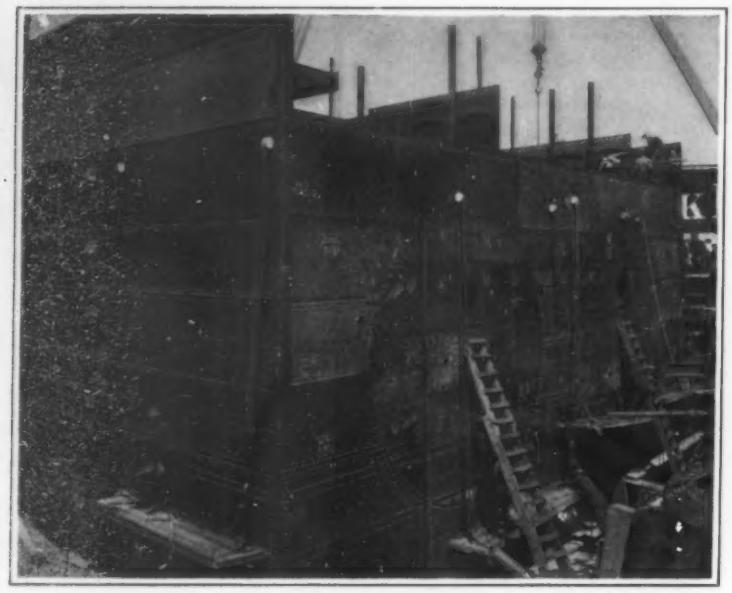
With pressure feed systems, everything is being forced *out;* and gasoline, being one half as heavy as water, will find a vent where water will not. And this leakage tendency is constant.

Because of this continual pressure upon the gasoline in forcing it to the carbureter, every time the car goes over a rough spot in the road the float in the carbureter "jumps," allowing an over-rich mixture to pass through the carbureter into the motor. This forcing of gasoline through the carbureter is not only what accounts for the tremendous saving in gasoline when the vacuum system is used (anywhere from 10 up to 30 per cent), but it also induces carbon in the cylinders, and a sluggish, inefficient motor is the result.

On the other hand, the vacuum system is drawing everything *in*—drawing gasoline from supply tank to vacuum tank upon the same simple principle as you draw any liquid through a straw. Absolutely air-tight construction and connections are not necessary. There is always sufficient gasoline in the vacuum tank to feed the carbureter in order to start, and the slightest suction of the motor after starting continues to supply gasoline to the vacuum tank, from which it fails in a positive even flow to the carbureter, no matter what the conditions or grade. And the most satisfactory part of it all is, it works absolutely automatically.

Chicago, Ill. GRIDLEY ADAMS.

Chain Holder for Book Shelves.—A recent patent relates to a method for holding sets of book shelves or the like by means of chains instead of the usual cords for hanging shelves. In one combination there are for instance two or three shelves, and on the side next the wall, a straight chain passes between two nails or hooks in the wall. On the outside, the chain is vertical between the shelves, but then passes back from the level of the top shelf to the wall hook above, hence at an angle, and the same for the bottom. The use of a chain is much preferred on account of affording an easy means of attaching the shelves to the chain, and of adjusting the space between shelves by the links of the chain, which latter passes through holes in the corner of the shelves. Another makeup uses four vertical chains and four separate ends.



Building the double caisson at the foot of Montague Street, Brooklyn.

Note the bulkheaded openings through which the shields will pass.

The working chamber of one of the Old Slip caissons.

The caisson is lowered by digging out the sand from under it.

Railroad Building Under and Over the Streets of New York—III

Tunneling Through Rock and Sand in the Bed of the East River

REFERENCE to the map of the Dual System of Rapid Transit of the city of New York, which was published in the SCIENTIFIC AMERICAN of July 10th, will show that the toe of Manhattan Island, below Fulton Street, is to have five parallel subway lines. Of these the middle line is the existing subway that runs down lower Broadway, while the two outer lines belong to the same system, namely, that of the Interborough Rapid Transit Company; for it will be recalled that the line that runs under the extension of Seventh Avenue, branches at Park Place and West Broadway, one arm continuing down through Greenwich Street to a loop at the Battery, and the other crossing east to William Street and passing under the East River in a new tunnel that is being built from Old Slip, Manhattan, to Clark Street, Brooklyn. Sandwiched in between these Interborough Rapid Transit subways are two Brooklyn Rapid Transit subways, one being the Broadway line that turns into Church Street to clear the existing line on lower Broadway and the other an extension of the Centre Street loop, which will run down Nassau Street. These two Brooklyn Rapid Transit lines come together under the East River at the pierhead line between Piers 4 and 5 and run across in a new tunnel to Montague Street, Brooklyn. This tunnel, therefore, lies between the existing Interborough Rapid Transit tunnel and the new Interborough Rapid Transit tunnel to Clark Street.

Each of the new East River tunnels consists of a pair of tubes, of which the portions that are in earth will have to be driven by the shield method. The Interborough Rapid Transit or Clark Street tunnel will have a diameter of 17 feet 6 inches, while that of the Montague tunnel will be 6 inches greater to accommodate the larger Brooklyn Rapid Transit cars. The material these tunnels must penetrate is about as difficult as the subaqueous engineer may care to encounter. On the Manhattan side they have to run through rock; then they pass into a fine sand mixed with clay; at the middle of the river they cut through a rock reef; after this they must run through fine sand and clay again, while on the Brooklyn side they will encounter sand and gravel interspersed with many boulders.

The work on the northern, or Clark Street, tunnel will be particularly troublesome, because the grade has been so chosen that while the lower part of the tunnel will pass through rock, the upper portion will be in sand. Owing to the wash of the tide, the depth of water at the pierhead line is considerably greater on the Brooklyn side of the East River than on the Manhattan side, in fact, the depth is so great that the roof of the Clark Street tunnel actually breaks out of the natural bed of the river. (See Fig. 4.) Of course the shield method of tunneling is impossible and so an artificial cover is absolutely necessary.

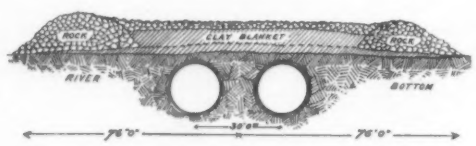


Fig. 1.—How the clay blanket was laid.

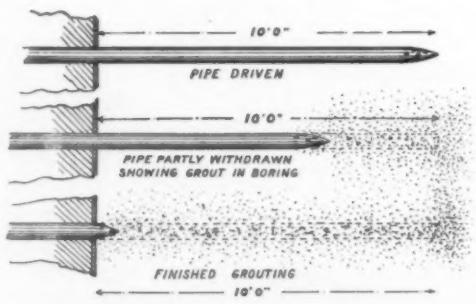


Fig. 2.—Cementing the sand outside the caisson.

A Blanket of Clay.

When the existing subway tunnel was driven under the East River, a great deal of trouble was experienced with blowouts, one being of such proportions that a man who was endeavoring to stop a leak was blown clear through the bed of the river and up to the surface. The outrush of air was followed by an inrush of water, which flooded the tunnel. The only method of stopping the hole in the bed of the stream and resuming operations was to lower a large canvas sheet over the spot and cover it with a thick layer of clay. It was because of that experience, largely, that it was deemed advisable in the present case to put down the clay blanket at the start, thus forestalling serious blowouts. In order to make a permanent covering, a special method of laying the blanket was pursued. At first a comparatively thin layer of clay about 150 feet wide was deposited along the line of each pair of tunnel tubes. Then on this clay two lines of rip-rap were laid. These served as retaining walls for clay that was deposited in the lane between them. In order to keep this clay blanket down and prevent it from being washed out by the tide, it was covered with a layer of rock, as indicated in the cross-sectional drawing. The thickness of the clay blanket varies according to conditions from 5 to 15 feet, and it has a width of about 140 feet. (See Fig. 1.) The clay was laid late last year, and by the time the tunnels are driven under it, it should have settled sufficiently to make a practically impervious cover that will facilitate operations greatly.

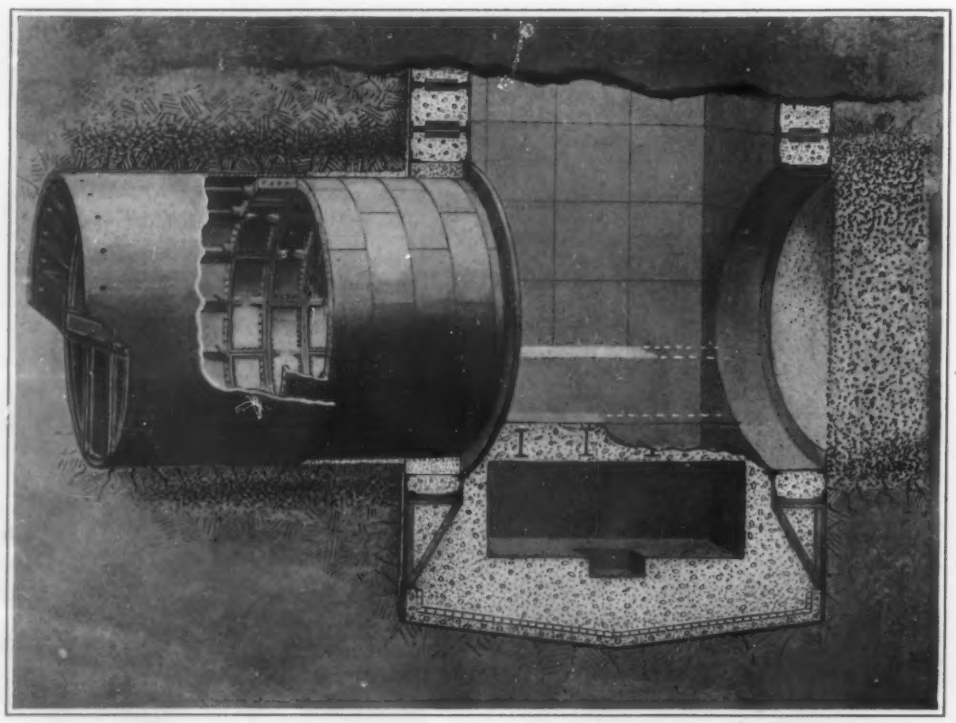


Fig. 3.—Section of a caisson, showing, at the left, a shield and part of tunnel and at the right, a wall of cemented sand in front of the shield opening.

The Clark Street Tunnel.

In order to avoid confusion we shall deal with each tunnel separately, taking first the northern pair of

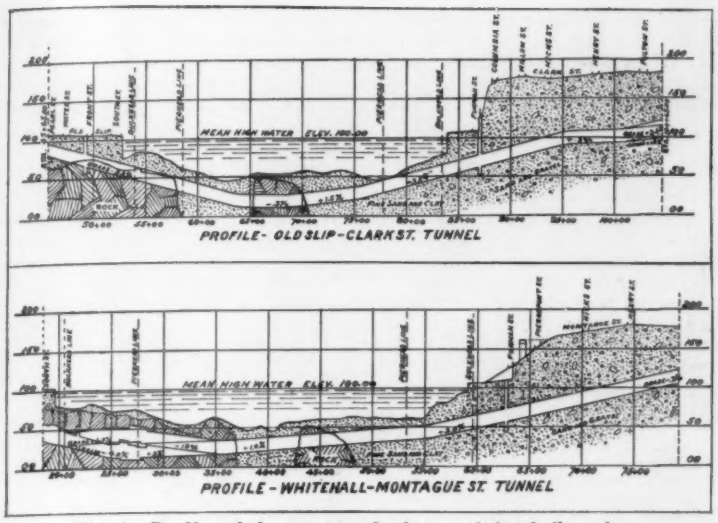

MEAN HIGH WATER ELEV. 100.00
PROFILE- OLD SLIP-CLARK ST. TUNNEL
MEAN HIGH WATER ELEV. 100.00
PROFILE - WHITEHALL-MONTAGUE ST. TUNNEL

Fig. 4.—Profiles of the two tunnels that are being built under the East River.

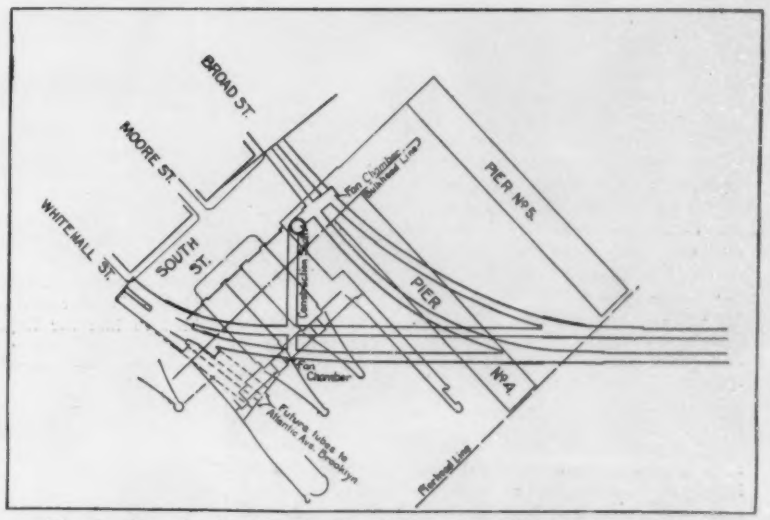


Fig. 5.—Map showing how the Broad Street and Whitehall Street tunnels come together under the East River.

tubes running from Old Slip, Manhattan, to Clark Street, Brooklyn. At the Manhattan end two large steel caissons, one for each tube, have been sunk down to rock and through it to subgrade. These caissons are 31 feet square outside and 24 feet square inside. In opposite walls are openings 19 feet 6 inches in diameter through which the shield can pass out. During the sinking of the caissons these openings were closed by means of steel bulkheads heavily reinforced with I-beams. At the Brooklyn end of the tunnel work on the two tubes will be extended in each direction from a double caisson. This enormous steel caisson measures 32 by 57 feet. The most suitable location for these caissons was on Furman Street, along the Brooklyn waterfront. But immediately behind the caisson are the Columbia Heights, which rise 68 feet above Furman Street. It was realized that this huge bluff of sand and gravel would tend to thrust the caisson out of line, and so the bank had to be excavated to give it a more gradual slope.

Solidifying the Sand Outside the Caisson.

It is always a difficult matter to break out of a caisson and start a horizontal drift through water-bearing material. In order to expedite this work and reduce the dangers commonly encountered, a very novel system invented by Mr. John F. O'Rourke is being used. In the bulkheads closing the openings for the shields, a number of holes are provided, each closed temporarily by caps. Also around each shield opening there is a ring of capped holes. After the caisson has been sunk down to grade, pipes are introduced through these holes, and forced out to a distance of 10 feet from the face of the caisson. Through these pipes, which are formed with perforated heads, grout is forced while the pipes are gradually withdrawn and at the same time rotated. (See Fig. 2.) The result of this is that a mass of cement is forced out into the sand, and soon sets, forming a solid wall. (See Fig. 3.)

Such a wall has been formed in one of the shield openings so far, and the bulkhead has been removed without danger of flooding the caisson. The method of procedure now is to assemble the shield within the caisson on a cradle that leads to the opening. Above

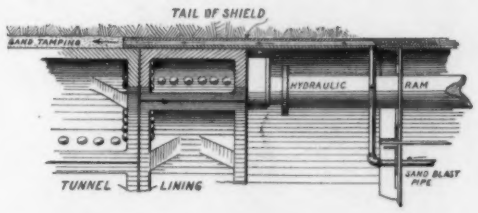


Fig. 6.—Means for tamping sand behind the shield.

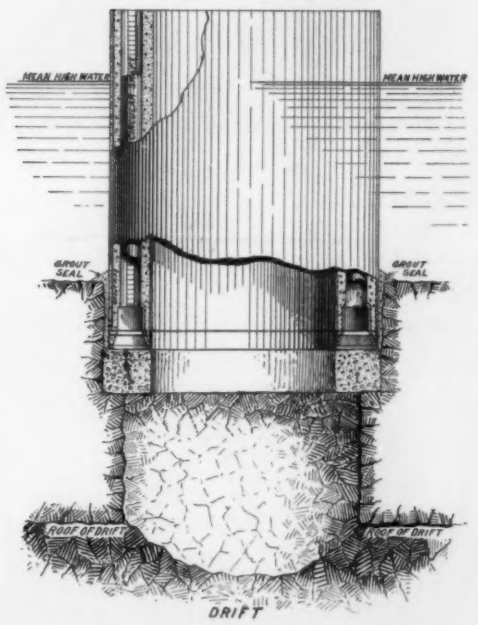


Fig. 7.—Section through the big circular caisson.

it a deck is being built across the caisson so as to form a large working chamber in which compressed air may be maintained. After the shield has been erected a ring of the cast iron lining will be set up within the tail of the shield in the ordinary manner, and the hydraulic jacks of the shield will be operated. At first they will force the rings back instead of forcing the shield forward. The jacks will be withdrawn and a new ring of lining will be set up in advance of the first ring. Ring after ring will be added until the lining is forced against the opposite wall of the caisson, when further operation of the jacks will cause the shield to move forward.

After the shield passes through the opening in the caisson, the cemented sand ahead of it will have to be cut away in advance of its cutting edge. The upper part of the shield will project forward as indicated in Fig. 3 to form an "apron." Grout pipes will lead up to and open out through the face of the apron, so that when the shield emerges from the grouted sand fresh grout can be pumped into the sand to solidify it. Our drawing indicates these openings in the apron, but the grout pipes are not shown. Of course, after the shield has entered the opening in the caisson, it will be a simple matter to prevent water from leaking around it by using suitable packing. When the shield has proceeded far enough beyond the caisson the tunnel will be closed by a bulkhead in which an airlock will be introduced according to the usual practice. Thereupon the deck will be removed from the caisson, for the air pressure can be confined to that part of the tunnel which lies between the face of the shield and the airlock.

Sand Packing Behind the Shield.

The contractors of the present tunnel have learned a lesson from the experiences of the builders of the existing subway and of other subways driven by the shield method. As the shield fits over the end of the tunnel, it must necessarily be of larger diameter than the tunnel lining, and consequently it makes a larger hole in the ground than is necessary. This forms a void around the tunnel lining that is gradually filled by settling of the ground overhead. When the existing

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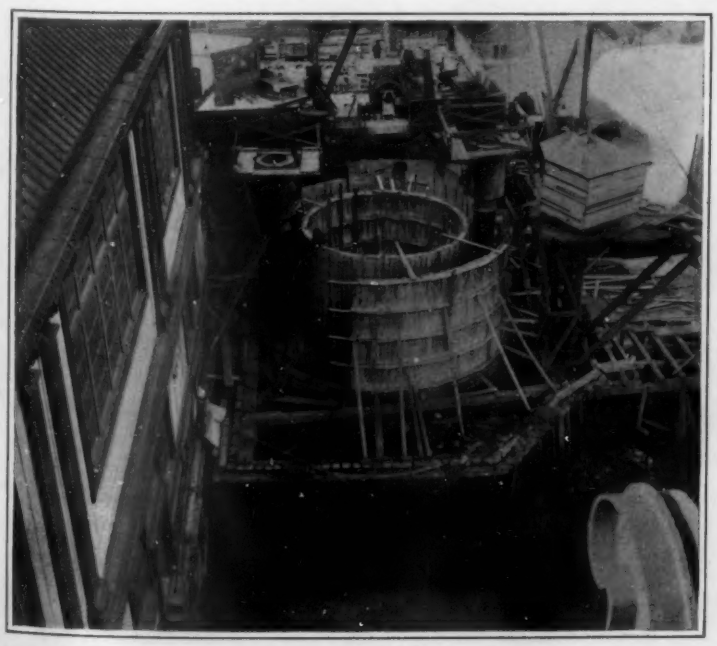


Putting up the forms for the circular concrete caisson.

The 35-foot concrete caisson as it was being lowered to rock.

William Wallace Campbell

By Marcus Benjamin, Ph.D.

FOR the first time in the history of the American Association for the Advancement of Science that great scientific organization will meet on the Pacific Slope and its sixty-seventh meeting will be held in San Francisco during the week beginning on August 2nd. Whenever practicable the presiding officer has been selected from those scientists who lived in the vicinity of the meeting place, and so this year the director of the Lick Observatory on Mount Hamilton has been wisely chosen as America's most representative man of science.

William Wallace Campbell is of Scotch ancestry, as his name clearly indicates, and is the son of Robert Wilson and Harriet Welsh Campbell. He was born in Hancock County, Ohio, on April 11th, 1862, and there spent his boyhood days.

His early studies were made in the public schools in the vicinity of his home and were continued until 1877 when he entered the Fostoria High School, where he remained for three years. For a year thereafter he followed the excellent practice of teaching and so learned from experience how best he himself might impart knowledge. Ambitious for greater information, he entered in 1882 the University of Michigan in Ann Arbor, where he was graduated four years later with the degree of B.S. in civil engineering.

He was promptly called to fill the chair of mathematics and astronomy in the University of Colorado in Boulder, but in 1888 he returned to his alma mater to accept the appointment of instructor in astronomy and assistant in the Detroit Observatory, which place he held until 1891, making a specialty during these years of comet observations and orbit computations.

His next appointment was to the charge of the spectroscopic department in the Lick Observatory, then under the direction of the late Prof. Edward S. Holden, where he gave much attention to the study of new stars, variable stars, various classes of bright-line stars, comets, etc. Later he was specially engaged in determining the radial velocity of the brighter stars by means of the Mills spectrograph attached to the 36-inch refracting telescope.

On the death of the lamented Keeler in August, 1900, he was made acting director of the Lick Observatory, which appointment was made permanent on January 1st, 1901, since when he has continued to hold this most important astronomical directorship in America and one indeed which is scarcely equaled in prestige anywhere in the world. While he has been director, there has naturally been much routine work to be attended to, but he has found time to continue his observations of the radial velocities of the stars, and in recent years to measure the radial motions of about seventy nebulæ, both at Mount Hamilton and in Santiago, Chili, a work of remarkable importance. It was in connection with these undertakings that he organized in 1903 the expedition to Santiago through the munificence of the late Mr. D. O. Mills, which had for its purpose the determination of the motions of the bright stars in southern skies that were not visible at Mount Hamilton, thus extending the work over the entire heavens. Director Campbell and his colleagues and associates in both hemispheres have observed the motions of about seventeen hundred stars in all parts of the sky. The results for the individual stars have been used by him to study the motion of the solar system through space, the motions of the stars as functions of their spectral classes, the scale on which the stellar system is constructed, the evolution of double-star systems, and other problems of large cosmical significance.

Director Campbell has had charge of the following eclipse expeditions that were sent out from the Lick Observatory, namely, to Jeur, India, in 1897-8; to Thomaston, Ga., in 1900; to Alhama, Spain, in 1905; to Flint Island, Pacific Ocean, in 1908; and to Kief, Russia, in 1914.

The results of his many valuable contributions to science have for the most part appeared in such important publications as the *Astronomical Journal*, *Astronomische Nachrichten*, *Astrophysical Journal*, *Bulletins* of the Lick Observatory, and the publications of the Astronomical Society of the Pacific. It is obviously impossible to discuss these in detail in this place, but of their merit I venture to give President Mas's words when he presented the gold medal of the Royal Astronomical Society in 1906 to Prof. Campbell "for his spectroscopic researches, which have greatly increased our knowledge of stellar motions." He said, "our science is indebted to him for important advances secured by researches most excellently planned, and carried out with a skill, persistence, and energy which command our highest admiration."

William Wallace Campbell.

President American Association for the Advancement of Science.

Prof. Campbell has enriched the literature of his chosen science by two large volumes. The first of these "Elements of Practical Astronomy" (1899) was written as a text-book during his professorial years at the University of Michigan and is still extensively used in many universities. His Silliman lectures were collected into a volume entitled "Stellar Motions" (1913), which is described by reviewers as a praiseworthy treatise that presents a "complete summary of research on stellar motions, especially as determined by the spectrograph." It is also referred to as "an epoch-making volume for which all astronomers will heartily thank the author."

Among the many recognitions of his unusual ability as an astronomer that have come to him may be mentioned his selection as Silliman lecturer at Yale University in 1909-10, and his appointment by his colleagues in the National Academy to deliver the William Ellery Hale lectures in 1914. He has received the Lalande medal of the French Academy of Sciences (1903); the medal of the Royal Astronomical Society of London (1906); the Draper medal of the National Academy of Sciences (1906); the Janssen medal of the French Academy of Sciences (1910); and the Bruce international medal of the Astronomical Society of the Pacific (1914).

From his own University of Michigan he received in 1899 the degree of M.S., and in 1905 that of Sc.D., while a similar degree was conferred upon him by the University of Pittsburgh in 1900, and that of LL.D., from the University of Wisconsin in 1902.

Director Campbell is a foreign associate of the Royal Astronomical Society, a member of the Astronomische Gesellschaft, and of the Swedish Academies of Sciences in Upsala and Stockholm, and of the Academy of Sciences in Montpellier, France, as well as a foreign member of the Society of Italian Spectroscopists. In the United States he is a member of the American Astronomical Society, the Astronomical Society of the Pacific, the American Academy of Arts and Sciences, the American Philosophical Society, and since 1902 of the National Academy of Sciences.

His membership in the American Association for the Advancement of Science is comparatively recent; for he joined it only at its Denver meeting in 1901. He was quickly advanced to the grade of fellow, and at the Philadelphia meeting last winter was selected by his scientific colleagues to preside over the first meeting to be held west of the Rocky Mountains, thus achieving the "blue ribbon" of science in the United States. Few astronomers equal him and none surpasses him.

New War Cars for Our Army

A FLEET of eight military cars recently left Chicago for the Pacific Coast under the command of Col. R. P. Davidson, head of the Northwestern Military and Naval Academy, accompanied by expert observers from the War Department.

Included in the fleet is an officers' reconnaissance car, equipped with special Ross military rifles, map tables, and instruments for making road and contour maps, a dictating machine, a periscope for observations from behind walls or other defenses, altitude indicators, range and elevation finders; in fact, every instrument helpful in making a reconnaissance report. A wireless car has a telescopic mast mounted on the running board, and is equipped with a special electric generator capable of producing a current of 110 volts. A second car carries, in addition to its wireless outfit, a Colt automatic rapid-fire gun and a powerful electric searchlight with heliograph shutter.

In the field kitchen cooking is done by means of a fireless cooker operated by electricity; there is also a general kitchen equipment. Special operating tables, surgical instruments and an X-ray apparatus make up the equipment of the hospital car.

A complete armor of bullet-proof steel, with openings for rifle fire, is provided for another car, which also mounts a Colt automatic rapid firer. This car carries a simple rope and windlass arrangement which would be found useful in actual warfare in extricating the car from a ditch, or dragging it up a steep embankment. One of the cars is designated as a quartermaster's car, and carries a Colt automatic gun, while there is also a balloon destroyer armed with a Colt rapid firer. The balloon destroyer is a hero of the Glidden tour of 1910, and by this time has had close to 80,000 miles of hard road travel and field work during different army maneuvers.

Theft Preventer for Automobiles.—Patent No. 1,139,757, to Leo Ehrlich of St. Louis, assignee of Francis K. Fassett of Dayton, Ohio, provides an automobile with means so that it may be disabled and with a number of independent manually operated elements, one of which may be operated to remove the disability so that the automobile can be operated, while if any other one of the elements be operated it will not remove the disability but will cause an alarm to sound.

An armored automobile for the United States Army.

The hospital car with its equipment set up for service.

Specimen of wood bored by "Ship-worm" (*Teredo Navalis*).

Burrows of bark beetles, showing "mother gallery" (in which the female lays her eggs) and larval burrows. They trace curious and beautiful patterns on the surface.

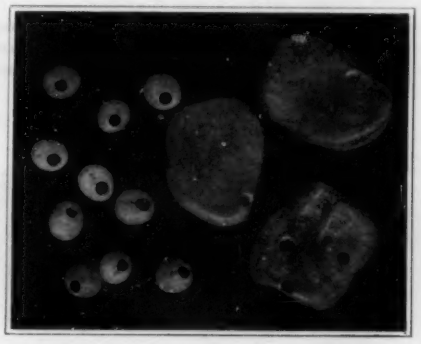
Burrows of wood-boring beetles in fir branches under bark. These insects subsist upon the fragments of wood which they rasp away with their powerful jaws.

Burrows of *Teredo Navalis* in wood. This creature works its way into wood; not rotten wood, but good, solid oak or teak.

The tube of *Cyphus*—a mollusc which constructs a shelly tube, in sand.

Stag beetle boring into wood. The hinder end of the body acts as a lever to thrust the insect forward.

Types of Aspergilium—a species of sand mollusc. The tube is really the inner casing of its tunnel.



Beans and peas from which beetles have emerged. The range of the insect's boring power extends through all fibrous growths from soft vegetables and dead, sickly timber to hard, live wood.

The Bivalve shell known popularly as Angel's Wings. Fishermen call it piddock.

Limestone rock bored by Pholas. As it works its way it becomes a lifelong prisoner in its own tunnel.

Burrowing Animals

Borers That Wend Their Way Even Through Rock

By Percy Collins

BURROWING animals constitute one of those natural groups whose members, irrespective of their true affinity, are bound together by similarity of habit. They are found in all the more important divisions of the animal kingdom. Many instances might be cited from among the mammals, the reptiles and the birds, but the most striking engineering feats are performed by certain of the invertebrates.

We will take as our first example the mollusc known to fishermen as the piddock. Its scientific name is *Pholas*, but its two-valved shell has been given the pretty, popular name of "angel's wings," the reason being perfectly obvious after a glance at the creature itself. Now, the mollusc which resides in this gaping shell is very much like an oyster or a clam, so far as its bodily aspect is concerned. It seems to be very flabby, and very much lacking in what we term "brain power." Yet this tenant of the "angel's wings" is capable of burrowing into hard rock, sinking downward gradually as its shell grows, just as though it were merely working itself into sand. As most people know, a great many kinds of shellfish burrow into sand, and this habit renders them safe from many enemies. Certain fishes, however, plough up the sand, and crack and eat all the molluscs they can discover. And it is probable that the persecution of these fishes, or rather, of their ancestors, brought about the rock-tunneling habits of the piddocks. Sand burrows were unsafe. Hence the piddocks began to burrow into rocks and stones instead. Commencing in youth, they pass the whole of their lives in working their way into these hard-grained substances, and are thus able to set their would be enemies at defiance.

As it works its way into the rock the piddock becomes a lifelong prisoner in its own tunnel. Increasing in size, it works its way deeper, the hole gradually becoming larger. But as the lower part of the piddock's shell is much greater in circumference than the upper, and as the creature is constantly growing, the entrance of its tunnel is soon too small to admit of its egress. This, however, does not matter to the piddock, whose sole concern is to hide. It takes all its food in solution. In other words, it sucks in sea-water through one tube, and discharges it through another, relying for its sustenance upon the minute scraps of foodstuff that chance to be in the water around it. Thus the piddock is quite happy and content in its self-made dungeon.

Another marine tunneler nearly related to the piddock is the Teredo, or "shipworm." This creature works its way into wood; not rotten wood, but good solid oak or teak. In past years it was a menace to the shipping of the whole world, but the advent of the steel ship put a limit to its depredations. Still, it menaces submerged timber of all kinds, if unprotected, and in Holland it is regarded almost as a national danger. Like the piddock, the shipworm makes its tunnels wholly for protection, for its does not feed upon the wood chips which it rasps away.

No one—not even men of science—can tell exactly how the piddock and the shipworm accomplish their wonderful boring feats. Some have thought that the work was done by means of constant rasping, produced by the movement of the shell; others, that the fleshy, muscular "foot" of the animal represented the chief tool; while still others have held that the constant action of the water, pumped, as it were, through the body of the mollusc against the sides of its crypt, effected the gradual enlargement necessary as the creature increased in size. As a matter of fact, it is highly probable that a combination of all these means render the shipworm and the piddock the expert tunnelers that we see them to be.

One point about the shipworm's tunnels is of especial interest. It is that they are lined with a layer of hard, shelly material in exactly the same way that human engineers line their borings with stone or brickwork, or with a tube of steel. This shelly lining prevents the wood from swelling and bulging inward, and insures the free passage of water along the tunnel. This is very necessary; for, as we have seen, the shipworm relies upon a constant supply of sea-water in order to feed. And as its tunnels are often of great length, it must make sure that no stoppage shall occur, or else run the risk of being starved to death.

A much thicker shelly lining is constructed by a cousin of the shipworm, known as Cyphus. It makes long tunnels, not in wood, but in the sand of the sea-bottom. Thus, if it did not construct a reliable casing within its burrow, it would very soon be cut off by a "fall" of sand behind it and perish like a miner imprisoned by a sudden subsidence of rock or coal. In fact, the shipworm and the Cyphus "shore up" the sides of their tunnels in exactly the manner which modern engineers agree to be the best—namely, by constructing a tube within the boring as the work progresses.

These shelly tubes are sometimes dug out of the sand by the South Sea Islanders in sections varying from four to six feet long and are valued highly by the finders as charms. They are placed above the doorposts of the huts. Vertical shafts are sunk by certain molluscs termed Aspergilium; and these, too, are lined with shelly material. The tops are roofed over in a very pretty way, the edge being frilled, and the covering studded with holes like the rose of a watering-pot. In this way undesirable intruders are kept out, while a free passage for water is preserved.

Among insects, we find an extraordinary number of larval forms that are fitted for burrowing. The most interesting are the wood-borers, many of which are able to drive long tunnels into the hardest timber. They subsist upon the fragments of wood which they rasp away with their powerful jaws. Of course these same jaws are the tools with which the actual work of burrowing is accomplished; but the methods by which the soft-bodied animal obtains its purchase and maintains its surprisingly rapid advance, are very imperfectly understood. Some of these larvæ (e. g., those of the *Lucanidæ* or Stag-beetles) have a curious sickle-shaped form, the hinder end of the body being curved downward beneath the head, where it acts as a lever by means of which the insect is thrust forward. But the cylindrical larvæ, such as those of the *Cerambycidæ* or long-horn beetles, must gain their leverage by muscular expansion of their body-segments acting upon the walls of the burrow. In each case, however, the details call for further investigation.

The grubs of long-horn beetles play an important part in virgin forests by attacking the trunks of dead and dying trees, which they soon reduce to pulp. In this way they not only break down the effete organic matter, but rapidly return it to the soil, where it acts as manure to new generations of plant life. It has been said that but for the activities of these and other wood-feeding grubs, all natural forests would gradually be-

(Concluded on page 103.)

The Heavens in August

A Study of Short Period Variables

By Prof. Henry Norris Russell, Ph.D.

THE warm clear nights of summer offer the amateur the best chance for star-gazing in all the year, and, fortunately, he has one of the finest portions of the heavens at his command in the splendid region of the Milky Way, which stretches from Cassiopeia and Cygnus through Aquila to Sagittarius and Scorpio, and forms a vast circle right across the summit of the vault of heaven.

The veriest novice can learn in an hour to identify the principal sky-marks within this region—the zig-zag line of Cassiopeia, now low in the northwest; the great cross of Cygnus, right overhead; the brilliant Altair in Aquila, with a fainter supporting star on each side; the little inverted "Milk Dipper" in Sagittarius, and the long curving line of the tail of Scorpio, dipping close to the horizon, and rising again to a group of brilliant stars at its end.

The possessor of a small telescope will find rich hunting ground here, especially in the region between Aquila and Scorpio, and the student who has only his own eyes to aid him need not lack for interest. For example, there are now easily visible in this region of the heavens four of the most remarkable variable stars in the whole sky, whose changes in light may be readily followed without telescopic aid.

All four belong to the interesting and very puzzling class of objects known as the short-period variables, or, as they are often now called, the Cepheid variables, from their most prominent example, the star Delta Cephei.

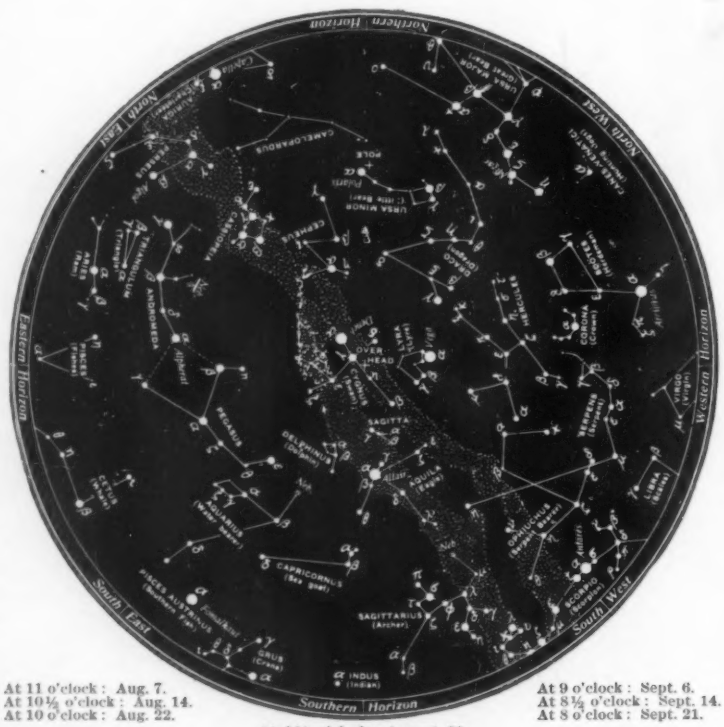
This star is shown upon our map, though not marked with its Greek letter, as a near neighbor of ζ Cephei, which is so marked. Or it may be found by sweeping the eye along the Milky Way from Cassiopeia toward Cygnus. Just about half way between these constellations, and in the very middle of the galaxy, is a little triangle of stars of the fourth magnitude, which is the most prominent configuration in the vicinity. The sides of this triangle are very unequal, and its sharpest angle points toward Cassiopeia. The star at this angle is the variable which we are seeking. Its two neighbors, Zeta and Epsilon Cephei, neither of which is variable, form admirable standards of comparison in estimating its brightness.

A few nights of watching, recording each time the brightness of Delta compared with the neighboring stars, will reveal a conspicuous variability. At maximum the star is of magnitude 3.7, very nearly equal to the brighter of its neighbors, Zeta Cephei, while at minimum it is of magnitude 4.6, which means that it is just about half as bright. A longer study would reveal that the variations in brightness were periodic, the maximum being reached at intervals of about five and one third days. Many years of observation have shown that this periodic variation is perfectly regular. Discovered by Goodricke in 1784 it has ever since conformed accurately to a period of 5 days 8 hours 47 minutes and 37 seconds, and there is every reason to suppose that it will continue indefinitely to do so. The character of the variation is also always the same. Starting at minimum we will find it rising to maximum in a day and a half and falling in brightness more gradually, so that it takes nearly four days to return to its minimum light, and the changes as observed at different times follow the same curve very closely.

The star Eta (η) Aquilae, which is now also easily observable, was found to be variable by Pigott in the same year as that on which Goodricke detected the variations of δ Cephei, and behaves very similarly, running through almost exactly the same range of visual brightness, but with a period of 7.17638 days. Here again the increase of light is much more rapid than the decrease, occupying some 2¼ days, or a little less than half as long as the latter.

This star, though not shown on our map, may be very easily found on a line between δ and θ Aquilae, and a little nearer the latter. It is nearly as bright as these two stars when at maximum, but much fainter at minimum. The other two variables of this sort which are now easily observable lie farther south and are known as ω and χ Sagittarii. The first of these is about a degree north of the bright star γ Sagittarii, which is marked on our map, and the second lies about two fifths of the way from this to θ Ophiuchi (also shown on the map) and is the only bright star near this line. The character of the variation is in both cases very similar to that of the stars previously described. ω Sagittarii varies from magnitude 4.3 to 5.1 in a period of 7.595 days, the rise in brightness taking about half as long as the fall, and the maximum being a little more than twice the minimum light. In the case of χ Sagittarii, the range of variation from magnitude 4.4 to 5.0 makes the minimum brightness 55 per cent of the maximum, while the period is 7.0118 days and the increase of light (unlike the stars previously described) is hardly more rapid than the decrease.

These four stars, so similar in their general characteristics, are typical examples of a considerable group of variables, of which between 150 and 200 are now known, though the periods of only about 100 have been accurately determined. These periods range from about forty days down to three hours—the shortest period of any known variable star. In addition, there are hundreds more of variable stars in the great globular star clusters whose variation is of this type—the periods of these "cluster variables" being usually not far from twelve hours, and many more again in those remarkable isolated outlines of the Milky Way known as the Magellanic clouds, with periods ranging from a couple of days to several months. It is, therefore, evident that in this sort of stellar variation we meet with a very important cosmical phenomenon. To unravel its nature has proved one of the most perplexing problems of astrophysics, and, after many years of effort, a satisfactory theory seems still remote. Many interesting facts, at least, have been brought to light; but we must postpone an account of them until next month.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: August 29.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens.

The remaining constellations are easily identified. Capricornus and Aquarius occupy a dull region in the southeast. The bright star below them is Fomalhaut, in the Southern Fish. Due east we see the great square of Pegasus, and to the left of this Andromeda, with Aries below and Perseus farther to the left. The two Bears and Draco are conspicuous in the northwest and north, Lyra is almost overhead, and Hercules, Corona and Boötes are below, to the westward, while Ophiuchus and Serpens occupy the southwestern sky.

The Planets.

Mercury is in conjunction with the Sun, and behind him, on the 14th, and is, therefore, practically invisible all through the month. Venus, too, is almost behind the Sun, and likewise practically invisible. On the morning of the 4th the two planets are in conjunction and but 18 minutes of arc apart, while Neptune is only a degree away on the other side. This simultaneous conjunction of three planets is rather remarkable, but, as they rise less than an hour earlier than the Sun, Neptune will be utterly invisible, though the other two planets may easily be seen with a telescope (provided with suitable finding circles) even in broad daylight, and in the same low-power field.

Mars, too, is a morning star, rising about 1 A. M. in the middle of the month. He is near the border of Taurus and Gemini and appears about as bright as Castor or Pollux.

Jupiter is in Pisces, approaching opposition, and rises about 9:15 P. M. on the 1st and 7:20 P. M. on the 31st. He is far brighter than any other celestial object in sight, and is correspondingly conspicuous.

Saturn is a morning star, in the middle of Gemini, and rises about an hour earlier than Mars. Since his rings are opened widely and send us nearly half as much light again as the ball of the planet, he appears much brighter than he did eight years ago, when his rings were edgewise toward us, and nearly equals Capella in brilliancy. Uranus is in opposition on the 7th, and is visible all night long.

There is an unusually good opportunity for identifying him this year, for at the end of the month he passes close to the fourth magnitude star θ Capricorni. This star, though not shown on our map, may be easily identified, as it lies very nearly half-way between β and δ Capricorni, and a little south of the line joining them.

At the beginning of August Uranus is a little over 1 degree east of this star and about 12 minutes north of it. On September 3rd he passes due south of the star at a distance of 7 minutes, and by the end of September he is some 45 minutes west and 20 minutes south of it. Uranus appears like a star of magnitude 5.7, and about five times fainter than the star which serves as a guide to his position. Early in August and late in September he can be seen with the unaided eye on a clear dark night. Near September 1st he will be too near Theta Capricorni to be observable without an opera glass; but the smallest instrumental aid will make it easy to follow his motion.

Neptune, as already stated, is close to the Sun and invisible this month.

The Moon is in her last quarter at 4:27 P. M. on the 2nd, new at 5:52 P. M. on the 10th, in her first quarter at 9:17 P. M. on the 17th, and new at 4:40 P. M. on the 24th. She is nearest the Earth on the 20th, and farthest away on the 4th. During the month she is in conjunction with Mars on the 6th, Saturn on the 7th, Neptune and Venus on the 9th, Mercury on the 10th, Uranus on the 23rd, and Jupiter on the 26th.

At the new Moon on August 10th there is an annular eclipse of the Sun. Though this begins before the Sun has set over the United States, the Moon's shadow strikes the Earth far to the southward, and no eclipse is visible at all from any part of North America.

Observers in Hawaii, however, will see a very large eclipse at noon, with the Sun nearly overhead, and those in the Philippines may observe the end of a partial eclipse just after sunrise. The track along which an annular eclipse is visible extends for a great distance across the South Pacific, but does not pass over any land of importance. The computed duration of this phase is a little over one and a half minutes.

Southport, Conn.

How Old Are Oysters?

AS the result of examinations of the surface lamellæ of the shells of over six hundred oysters of known age, and of various ages from eighteen months to six years, made by Miss A. L. Massy, and noted in the *Scientific Investigations* (English) under the section on fisheries, the following conditions prevailed as to the relation between age and the number of surface lamellæ, or growth rings. Miss Massy states that an oyster of eighteen months or two summers appears to possess at least two rings, but may have as many as five; one of three summers has at least two rings, but may have six. A four-year-old oyster may have only three rings, or may possess seven or eight.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SUSPENDERS.—S. MARTIN, Chelsea, Mass. The suspenders are for use by men engaged in severe manual labor, and the object of the invention is the production of means whereby elastic strips may be connected to the non-elastic portions of the suspenders without causing any roughened or enlarged places upon the body engaging faces of the suspenders.

HOSE SUPPORTER.—T. P. FORD, 47 Brevoort Place, Brooklyn, N. Y., N. Y. This invention provides a hose supporter arranged to permit the user to conveniently and quickly engage the hose material with the supporter and to readily adjust the parts to securely hold the hose material in place without danger of tearing it.

Electrical Devices.

STARTING BOX.—M. TAIGMAN, 239 Wooster St., New York, N. Y. The invention provides an apparatus with a series of interchangeable unit devices to obviate the need of structural alteration in the apparatus when replacing a member thereof; provides a relatively cheap circuit-breaking element to avoid arcing between the starting arm and resistance terminals of the box; completes the circuit controlled by the box by placing the elements of the box in service position; and provides for the moving operative members of the apparatus.

Of General Interest.

PACKAGE TIE.—E. F. KING, Brown's Summit, R. F. D. No. 2, Guilford Co., N. C. This invention has reference to package ties, and one of the principal objects of the invention is to provide a package tie with means for positively engaging and clamping the cord when in tied position, for preventing accidental loosening or withdrawal of the same.

SCREEN WIRE CLOTH RACK.—W. G. NEWMAN, care of Stuveil-Paterson Hardware Co., Salt Lake City, Utah. This invention relates to improvements in racks for displaying and dispensing screen wire cloth or other material put up in rolls. It provides means for displaying wire cloth of various width, and means for unrolling the cloth and for cutting off squarely pieces drawn from the roll.

GETTING OR EXCAVATING PEAT.—T. RIGBY, Station Hotel, Dumfries, Scotland. The object here is to insure continuity of supply of peat from the bog or other deposit which is being worked to the locality at which it is being employed, e. g., peat carbonizing apparatus situated near the bog, independently of cold winter temperatures, which result in freezing of the bog or deposit, and generally produce periods when gathering becomes impossible and work is interrupted.

PROCESS FOR THE UTILIZATION OF PEAT.—T. RIGBY, 61 Loreburn St., Dumfries, Scotland, and N. TESTRUP, 3 Dean Farrar St., London, S.W., England. Drying of peat artificially has never found practical application owing to the large amount of heat required to effect drying in relation to the calorific value of the dried peat fuel obtained. The present invention provides a process capable of application on a large scale for utilizing peat by gasification in by-product recovery gas producers.

CAN SIFTER TOP.—J. T. LAGOIS, 149 E. 35th St., Brooklyn, N. Y., N. Y. This invention improves and simplifies the construction of can sifter tops so as to be reliable and efficient in use, and so designed that there will be no loss or waste of the contents of the can in shipment or handling in the trade.

STANDING WEATHERPROOF SEAM FOR FELT ROOFING.—H. VON UFFEL, Prince George Hotel, New York, N. Y. This invention improves the cap construction for the joints, whereby the caps can be easily and quickly applied without the need of nails or other fasteners which penetrate the roofing material, and yet the caps are firmly retained in place in a manner to prevent wrinkling or buckling of the roofing material and permit of expansion and contraction.

FERTILIZER AND PROCESS OF MANUFACTURING SAME.—L. KERN, Mundhergerdamm No. 40, Hamburg, Germany. By means of this invention a fertilizer in powder form is produced in a very economical manner and is particularly useful in fields used for raising plants rich in silicic acids, such as corn, cereals, grass, etc., and for use in moors and like ground which requires enrichment in silicic acid.

FILTER.—W. P. LASS, Speel River Project, Juneau, Alaska. The inventor provides a filter with the filter members inclosed in a drum, and having means for discharging sands and solids which may accumulate in the drum in the filter member, and without it being necessary to reduce the pressure in the drum which is used for forcing the filtrate through the filter member.

WATCH PROTECTOR.—M. FLEISCHER and A. C. O. BOCK, care A. Bock, 405 5th Ave., Brooklyn, N. Y., N. Y. This invention has for its purpose the provision of an improved construction which automatically operates when the chain is pulled, and when operated will positively prevent the removal of the watch from an ordinary pocket.

CIGARETTE BOX.—A. MENDELSON and S. J. GOLDBERG, 482 Marcy Ave., Brooklyn, N. Y., N. Y. This invention has special reference to improvements in boxes for holding cigarettes and the like, and more particularly to means for withdrawing the cigarettes in order to be grasped without handling or breaking the remaining cigarettes in the box.

PROJECTILE.—G. DAMER, U.S.S. Brenham, Navy Yard, Brooklyn, N. Y., N. Y. The projectile is more especially designed for destroying wire entanglements, aerial craft, masts, fighting tops, wireless aerials and like structures, and arranged to permit of firing the projectile from a gun the same as an ordinary projectile and without danger of injuring the bore of the gun.

Hardware and Tools.

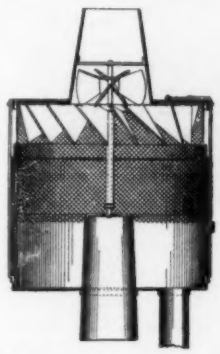
COMBINATION LOCK.—N. S. G. BESHAROV, 850 Main St., Paterson, N. J. The general objects of the invention are to improve the lock so as to be comparatively simple and inexpensive to manufacture, thoroughly reliable and efficient in use, and so designed that the horizontal dimension of the lock can be materially reduced so as to be better accommodated to doors of present construction.

INVISIBLE SURFACE HINGE.—O. KATZENBERGER, 215 W. Huron St., Chicago, Ill. This invention relates to improvements in spring hinges, and particularly to an invisible surface hinge, and has for an object to provide an arrangement which may be readily applied or removed without injury to the door. It provides a hinge which when applied will not be visible from either side of the door.

Heating and Lighting.

COMBINED OIL BURNER AND STEAM GENERATOR.—A. D. MARCOTTE, care of Eunice Carriage and Machine Shop, Eunice, La. The inventor employs a steam-generating coil which is in practice preferably located upon the grate of any boiler furnace, in which crude oil is used as the fuel. One leg of such coil is connected with a water-supply tank and the other end with a steam receiver, which is in turn connected with a crude-oil burner adapted to atomize and feed oil to the coil.

HEATER AND VENTILATOR.—O. JOHNSTON, Huntington, L. I., N. Y. This invention comprises a drum adapted to receive stove pipe connections at the top and bottom. A cold air inlet pipe also leads into the drum at the bottom from a point near the floor of the room. The air inducted through the inlet pipe may be carried off through the top of the drum to the chimney, to effect ventilation. The drum is



HEATER AND VENTILATOR.

equipped with means to check the draft to the chimney after the smoke and noxious gases have passed off, and with means whereby the air taken in at the air pipe and heated in the drum, is directed outward into the room, together with more or less of the hot products from the stove or furnace when the smoke and noxious gases have passed off.

Household Utilities.

HANDLE CONNECTION.—E. NAHR, 1050 Elm Ave., Long Beach, Cal. The mop head and handle of this mop are equipped with novel co-acting bearing elements to effect an adjustable connection of the handle with the head. The handle may be given various angular positions relatively to the mop head and the handle will be maintained in the adjusted position, a spring being sufficient to prevent accidental displacement of the handle.

VACUUM CLEANER.—A. BOOGHER, Fayetteville, N. C. The object here is to provide a device particularly adapted to ready and convenient handling and to obviate the difficulties incident to the machines now in use in cleaning ceilings and walls and ornaments thereon and small corners and other places where the machines cannot be taken.

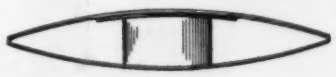
SCREEN.—J. A. LENHOFF, 3305 Madison St., Wilmington, Del. This invention relates to insert screens for windows, porches and the like, and one of the main objects thereof is to provide such devices which may be quickly and easily placed in position by unskilled persons, and which may be removed and replaced whenever desired without trouble.

COMBINED MORRIS CHAIR AND COUCH.—D. NASCA, Box 490, Fort Lee, N. J. By this combination a chair is produced, the back of which may be set at various angles for the user, which chair may be converted into a couch by unfolding the seat portion of the chair and by swinging the back downward, and in which chair the back portion is provided with means adapted to maintain said back at a proper angle to the main portion of the chair when the same is converted into a couch; and the arms of the seat section are adapted to form a support for said section when the chair is converted into a couch.

Machines and Mechanical Devices.

STREET SWEEPER.—A. BROWN, Plainfield, Ill. The invention provides a wholly metallic structure in which the several operating parts may be driven from the motor used to propel the vehicle and in which their adjustment either to compensate for wear or to throw the same into and out of operation may be readily and quickly accomplished with minimum labor.

SHUTTLE.—G. A. DONALDSON, Girard, Ill. This invention relates to shuttles or bobbins and more particularly to tatting shuttles. The object is to improve, simplify and cheapen



SHUTTLE.

shuttles of this character, as well as to provide a novel connection between portions thereof whereby they may be conveniently separated but held sufficiently tight to prevent accidental separation or displacement thereof.

AUTOMATIC SAW FILING DEVICE.—F. N. RUSSELL and O. S. LIND, 6210 Dorchester Ave., Chicago, Ill. This improvement relates to saw files of the automatic type and has reference more particularly to a device comprising a carriage mounted to move parallel to the edge of the saw provided with teeth and having a saw carrier mounted to reciprocate transversely of the edge at predetermined angles thereto.

LINE MARKING MECHANISM FOR COPY HOLDERS.—W. E. GRAY, 4356 Kenmore Ave., Chicago, Ill. This invention comprehends a copy holder to be connected with a typewriter and having a large number of adjustments of various kinds whereby the copy holder is given a large number of positions and the handling of the copy is facilitated in a number of distinct ways, the manipulation of the copy by the hand, however, being reduced to a minimum.

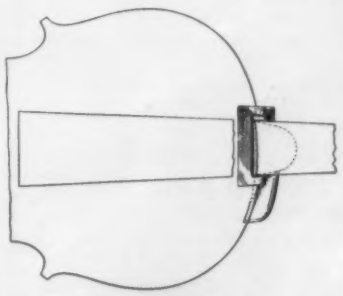
MACHINE FOR SAWING METALS.—E. O. ROTHMAN, 41 Great Percy St., London, W.C., England. This portable sawing machine is capable of being attached to a bench or any carrier, or on the piece to be cut itself, allowing to cut square or obliquely and to vary at will the pressure with which the saw is applied, according to the size of the piece and to the nature of the metal.

MACHINE FOR FLANGING CAN BODIES.—H. L. GUENTHER, 2821 N. Sichel St., Los Angeles, Cal. The object of the invention is to provide an improved machine for flanging can bodies arranged to simultaneously provide the ends of a can body with outwardly-extending flanges and to automatically remove the completed can body from the machine.

DRAIN TILE MOLDER.—O. POULSON, Brigham, Utah. The invention has reference more particularly to a mechanical molder which comprises a balanced revoluble core provided with means for packing the material in the stationary mold, and at the same time forming an interior smooth surface as the revolving core is removed within the mold.

Musical Instruments.

THUMB REST FOR VIOLINS AND SIMILAR MUSICAL INSTRUMENTS.—C. HAMLIN, 102 Hancock St., Brooklyn, N. Y., N. Y. The object in this instance is to provide a new and improved thumb rest for violins and similar musical instruments arranged to permit the player to readily finger the strings for high notes, at the same time permitting holding the fingers in correct position for pressing the strings forcibly down onto the finger board.

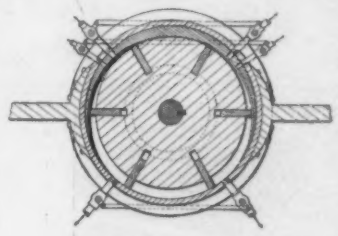


THUMB REST FOR VIOLINS AND SIMILAR INSTRUMENTS.

SOUND BOX OR THE LIKE.—J. HOFFAY, 500 5th Ave., New York, N. Y. The objects here are to obtain a vibratory action of the diaphragm free from the defects arising from the distortion of the stylus lever arising from the working of the stylus in the sound groove, and to obtain a vibratory action of the diaphragm free from the defects produced by the displacement of the stylus lever parallel to the diaphragm owing to the irregularities of the record.

Prime Movers and Their Accessories.

ROTARY ENGINE.—L. G. SMITH, St. Louis, Mich. The invention provides an engine which consumes relatively little fuel and takes up but little space; provides sliding pistons for the rotor which are maintained in constant contact with the casing interior surface by means of the engine actuating fluid, as steam or explosive gases, automatically; provides suitable valves for said casing, inlet and outlet, and which may be reversed in action to reverse the engine; and provides pistons formed of a plurality of parts, the outer of which are maintained in contact with the ends of the casing by means of springs, to prevent leakage of the actuating fluid.



ROTARY ENGINE.

ENGINE.—F. J. ZELLAR, Grand Haven, Mich. The object here is to arrange the rotary valve within the cover of the engine casing and connect the valve with a crank shaft through a crank pin, which has the advantage that the valve will have its own bearing within the cover and thus diminish the wear on the crank shaft bearing; and furthermore, by this arrangement the balance of the moving parts is more easily accomplished so that the engine will run smoothly and with less wear.

SINGLE VALVE FOUR-CYCLE EXPLOSIVE ENGINE.—J. KEISTER, Steubenville, Ohio. The invention relates to four-cycle engines of the single valve type, in which the valve is in the form of a sleeve or tube having separate inlet and exhaust ports adapted to register respectively with the inlet and exhaust ports of the cylinder during the suction and exhaust strokes of the piston, said valve having one stroke back and forth with each cycle of the engine.

Pertaining to Vehicles.

SELF-LAYING TRACTION TRACK.—W. E. BASSETT, 1260 Temple, Fresno, Cal. The invention pertains more particularly to endless self-laying tracks for the wheels of traction vehicles. The object is to improve devices of this character, to the end that efficiency in operation may be promoted, as well as simplicity of construction in the assembling and renewal of the parts.

Designs.

DESIGN FOR A FEED BAG FOR HORSES.—J. H. HUCKE, JR., 52 Madison St., Brooklyn, N. Y., N. Y. In this ornamental design for feed bags for horses the article is shown in a perspective view and in a front elevation.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—W. E. HUNTER, care of Economy Tumbler Co., Morgantown, West Va. Mr. Hunter has made two designs for an article of manufacture, each of which may be etched, stamped, printed, imprinted, embossed or worked on or in or cut upon any suitable glass, china, paper, cloth or other material, or upon any metal or other suitable material, and may be produced on or in or attached to any desired article of manufacture.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Railroads Over and Under the Streets of New York—III

(Concluded from page 97.)

tunnel was run through Joralemon Street, Brooklyn, the settlement that followed in the wake of the shield racked the buildings seriously on each side of the street, and damaged much property. It is believed that such settlement can be completely overcome in the present tunnel by a system invented by Mr. John F. O'Rourke. The tail of his shield is formed of three thicknesses of metal, the middle layer of which is cut away in places so as to form channels or ducts that open at the rear edge of the shield. By means of pneumatic pressure, sand will be forced from these ducts as the shield moves forward, so as to completely fill the void around the tunnel lining. This system is illustrated in Fig. 6. Experiments have been made with the system on a small scale and have proved very satisfactory.

The Montague Street Tunnel.

The contractors for the Clark Street tunnel are also building the Montague Street tunnel, and similar methods of operation are being employed. As in the Clark Street tunnel a large double caisson has been sunk at the waterfront on the Brooklyn side, but it was found possible to locate the caisson so far from the edge of the bluff that there was no danger of its being displaced. At the New York end the tunnel is very interesting because of the branches that come together under the river. As shown in the accompanying map (Fig. 5) one of the lines comes down Broadway and the other down Whitehall Street and one of the Broad Street tubes has to dip under and come up between the Whitehall Street tubes so as to avoid a grade crossing. Of course the work here is in solid rock and there is no engineering difficulty in making the connection, but there is a certain romantic interest in this work due to the fact that it is far under water and well out from the shore line.

A Thirty-five Foot Concrete Caisson.

Access to this work has been obtained by sinking a large circular caisson just within the bulkhead line, although actually out in the water. As this is a vital spot, a solid bulkhead was built around the spot where the caisson was to be sunk, so as to protect it from damage by lighters or barges that might smash up against it. It will be noticed that this caisson lies off the line of the two tunnels, but it is to form an emergency exit in a connecting tunnel running from one line to the other.

The caisson itself is very interesting because it is built of reinforced concrete, and is thirty-five feet in diameter. Some idea of its construction can be obtained from Fig. 7 and two of the accompanying photographs. The annular working chamber was 5½ feet wide and access to it was obtained through two airlocks. When it had been sunk down to rock a wide circular channel was cut in the rock and filled with concrete, so as to make a very effective seal. In introducing the concrete into the annular working chamber the buckets were emptied from the top of the caisson and had a vertical fall of some 70 feet. Then workmen inside spread the material as it came down.

It will be observed in Fig. 5, that two stub-end tubes branch southward from the Whitehall Street tunnel. These are to provide for a tunnel to Atlantic Avenue, Brooklyn, at some future date. By forming these stubs now a connection can be made at any time without interrupting traffic.

Other Subaqueous Tunnels.

The East River is to be crossed at Fourteenth Street by a new tunnel, but as yet the plans for its construction have not been given out. Further up at Forty-second Street, we come to the Steinway tunnel, which was begun twenty-three years ago as a private enterprise. After a varied history the tunnel was acquired by the city as part of the Dual Subway System, and on June 22nd of this year it was opened to the public.

The four-track tunnel under the Harlem

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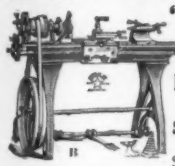

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River was described in detail in the SCIENTIFIC AMERICAN of March 29th, 1913, and September 27th of the same year. It will be recalled that a broad trench was dredged in the bed of the river, and in this steel sections of the tunnel were sunk and weighted down with concrete. The ends of these tunnels have been shut off from the river by means of bulkheads and connected with the land sections. The tunnel lining will have been completed before this article is printed.

(To be concluded.)

Burrowing Animals

(Concluded from page 99.)

come blocked up with dead timber. But from the standpoint of forestry, the majority of wood-boring insects must be regarded as pests, although their powers to injure have probably been somewhat exaggerated in the past, since many of the species confine their attacks to dead or sickly trees.

The great family *Scolytidæ* (popularly termed bark beetles) has of late years been closely studied, and their economy proves to be of great interest. Some genera are monogamous, while others are polygamous, and this distinction is indicated by the characteristic markings which each species leaves upon the surface of the wood, immediately beneath the bark. In the case of a monogamous species, the female, after hibernation, scoops out a small chamber in the bark of a suitable tree. She then takes a short flight, and returns with a mate, pairing taking place within, or close to, the chamber. The female now sets to work in earnest, drilling a long, straight tunnel between the bark and the wood, and depositing her eggs along it to right and left alternately. When the grubs hatch, each eats its way outward, more or less at right angles to the "mother gallery," and when full-fed pupates at the end of its burrow. In this way curious and beautiful patterns are traced upon the surface of the wood. It has been found, moreover, that the particular angle made by the junction of the larval with the maternal galleries differs in the respective species, and is thus serviceable as a means of identification.

In polygamous species, the male first excavates a roughly circular chamber beneath the bark, and therein receives from four to six females. After pairing, the females construct their respective tunnels, which all radiate from the nuptial chamber; and as the grubs in their turn bore outward from the egg-tunnel at all angles, very complicated patterns usually result.

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Void for Lack of Invention.—In Prepayment Car Sales Company v. Orange County Traction Company, the Ross and McDonald patent, No. 800,172, for a passenger car has been held void for lack of invention, and the same patent was held not infringed in Robinson v. Pay-As-You-Enter-Car Corporation.

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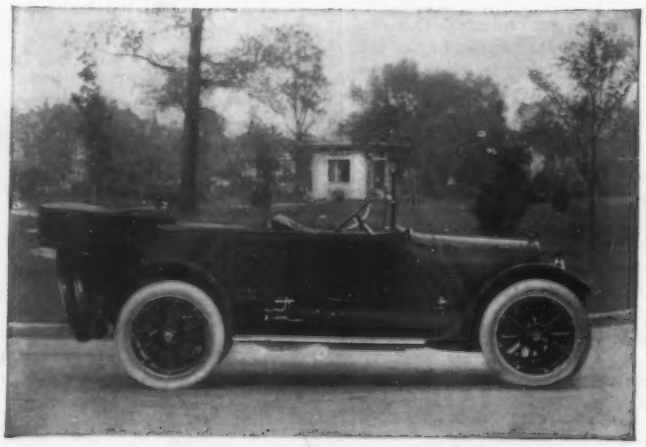

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